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THE

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THE ELECTRIC LIGHTING OF THE CITY.

THE course which events have taken during the past few months in regard to the electric lighting of the City district, illustrates with striking results how unwise a policy it is for any electricity supply undertaker to treat its consumers apathetically.

The City Company, which has up to the present done pretty well as it chose, now has to face actual competition. We do not suggest that if the supply had been satisfactory both as to charges and efficiency there would have been no agitation for a second service, for there is so much business to be done within the City area that covetous glances have long been cast upon it by parties anxious to come in and compete. But certainly the primary cause of the recent developments has been the lack of interest which the company has seemed to take in the needs of the private consumer. High charges for an inefficient supply have precipitated matters, and, along with the erratic procedure of the promoters of the company rendering the monopoly agreements null and void in the opinion of counsel, have led to such widespread dissatisfaction in the City that other companies found the agitation a profitable one for the furtherance of their objects.

The suggestion that the City authorities should take advantage of the City of London Company's unfortunate position, and damage the interests of its shareholders because of indiscretions on the part of the founders, has seemed to us from the first a quite improper way of doing "justice" to the City. Certain extreme socialistic views have been paraded in the Press about the gross injustice of the monopoly, and while we cannot help feeling that the company has taken autocratic advantage of that monopoly which it considered unshakable, we cannot agree that the Court of Common Council would have been altogether justified in adopting the sweeping measures recommended in certain quarters. We are of opinion that the Court's decision not to interfere with the company's monopoly, on condition that the consumers' charges were reduced to a certain figure and a supply of continuous current made available, was a most dignified attitude to assume.

The City Company will doubtless say that if they reduce their charges to any extent, the fresh demands will render more acute the difficulty of keeping pace with consumers' requirements. To a certain extent this is an argument in favour of competition. But we certainly think that the City Company damaged its interests very considerably by connecting to its mains a much larger number of lamps than the capacity of the plant running would allow it to supply efficiently. We fully appreciate the difficulties which all electricity supply works have lately been experiencing in laying down machinery rapidly enough to keep pace with the demand for current. But it is, we think, not

unreasonable to say that the probable demands of so promising a district as the City should have been foreseen with greater accuracy, so that plant might have been ordered in plenty of time, in order that there might be a minimum of waiting on the part of the consumer, and no possibility of a light at 70 or 80 volts pressure instead of 100 at his terminals at times of heaviest load.

But with all its consideration for the awkward situation of the company, the Court of Common Council did not possess the supreme authority in settling the question of competition, and doubtless it had this fact in mind when deciding upon the course to take. The Board of Trade proposes to itself break the City monopoly. This appeared to be pretty certain when, at the recent inquiry, Sir Courtenay Boyle alluded to the delicate position in which he was placed by the Corporation failing to say which of the several suitors was the most favoured. And it has also appeared for some time past that if the principle of competition were approved, the application of the Charing Cross and Strand Company was in a fair way for meeting with success.

The decision of the Board of Trade, in accordance with Sir Courtenay's recommendation, is to grant a provisional order to the Charing Cross Company, but not to the other two applicants. Sir Courtenay's conclusions are given in another column. He finds that "a competitive supply is desirable both in the interests of private consumers and of the public," and he advises that "the consent of the local authority be dispensed with in the case of the application" in question, the undertaker to establish a separate generating station for the City within two years from the date of the order. The Streets Committee has during the past week attended at the Board of Trade for the consideration of clauses.

The entire incident will serve a useful end if it reminds electricity supply companies that although their *raison d'être* is to make money, there is a consumer whose interests must be attended to as well as a shareholder whose capital must have dividends declared upon it. To neglect the consumer will assuredly endanger the interests of the shareholder, and the Board of Trade may step in and emphasise the fact. Municipal engineers, and even chairmen of the electricity supply companies, are continually finding that, other things being satisfactory, an increasing consumption means decreasing generating and distribution costs per unit up to a limit as yet undefined. Logically, one deduces that to reduce consumers' charges at the earliest convenient moment is advantageous to the company. Of course, one has to take into account the difficulty, which we have already mentioned, of getting machinery with the needed expedition to keep pace with the demand which may be reasonably anticipated. It is a satisfactory feature that latterly the electrical engineers of the larger areas of supply have been looking several years ahead, and ordering plant well in advance of requirements. Extravagant as some of these estimates may appear to the uninitiated Councillor, we shall not be surprised if they are considerably exceeded.

When occasionally orders have to pass into the hands of American manufacturers the English contracting engineer feels aggrieved. But the engineer having electricity supply works under his control generally appreciates the seriousness of his position; the time element is to him at the moment far more important than is the patriotism outcry. His estimates as to requirements are outrun, or perhaps his committee prefer to move slowly in voting money for extensions. In such a case he is to be pardoned for giving his contracts abroad. The difficulty would be in part overcome if the future demand were a more certain factor.

To return to the question of the City supply. We believe we are right in saying that the Charing Cross Company has safeguarded the interests of its consumers with financial success. We cannot do other than welcome the company upon its now almost certain entrance into the City. So far as the business outlook is concerned, there would appear to be room for both companies.

It is not for us to champion the cause of one company at the expense of the other. But while we adopt a perfectly neutral line, we cannot help feeling that the City Company may even yet assure for itself a continuance of the cream of the business by lowering its charges, and in other ways serving its consumers better. This view of the matter is doubtless under consideration by the directorate.

The Oscillograph.

In another column will be found an abstract of M. A. Blondel's paper on oscillographs, read last year at the meeting of the French Association at Nantes, which gives references to his earlier publications on the subject. M. Blondel laid down in 1893 the conditions to be met by a successful instrument of the kind, and proposed the precise form of construction that has since been carried out with such marked success by Messrs. Duddell and Marchant. M. Blondel, however, did not realise how great were the possibilities of his "bifilar" design, and elaborated an altogether different and inferior kind of instrument. The English investigators have followed M. Blondel's ideas very closely, notably that of throwing three independent moving spots on one screen simultaneously. The great advance made in galvanometry by the development of the moving coil and moving strip instruments is largely due to the work of the Central Technical College.

New Kashmir Railway.—According to the *Pioneer Mail*, a narrow-gauge railway is projected from Jummu to Srinagar, in the Kashmir Valley, about 180 miles in length, and at an estimated cost of £1,000,000. On account of the scarcity of fuel, and the abundance of water-power, together with the steepness of the gradients, Mr. Nethersole, the State engineer, has reported to the Government of India in favour of the use of electricity as the motive power. The generating station would be situated at Ramband, about midway between the termini, where a water-power of 100,000 H.P. is available. If the scheme is carried into effect, it will mark a huge step in advance; up to the present no electric railway, so far as we are aware, has been constructed with a length even one-tenth as great as this. The conditions are precisely those under which electric traction is at its best, and we see no reason why the project should not be carried out with entire success.

Institute of Chemistry.—On Thursday last week the annual dinner of the above Institute was held at the Trocadero Restaurant. Dr. Thomas Stevenson, the president, was in the chair. A distinguished company was present, and in response to "The Institute" toast, the president said that they now had nearly 1,000 members (fellows and associates), and 180 registered students. Mr. Justice Cozens-Hardy and Prof. Arrhenius replied for the guests.

THE GENERATION OF POWER FOR ELECTRIC TRACTION.

By J. GRAY SCOTT.

In the adoption and development of electric traction, we have, in this country, been forestalled by Continental and American enterprise.

The explanation is by no means obscure, particularly in the latter instance, for in America the present conditions are merely the result of *evolution*—rapid, no doubt—whereas the development of electric traction, or even electric lighting, in this country, involves *revolution*—essentially a slow process.

We may say that all tramways in this country were, up till recently, worked by steam, horses, and cable; and, in the absence of a superior system, appeared to fulfil our requirements.

The introduction of electric traction has resulted in the conversion of some of these older lines, and the equipment of several new ones, and it may be safely said that the general public, having realised the advantages and convenience of the electric tramcar, would not tolerate reversion to an older system.

It has been shown beyond doubt, that an electrical system, by its frequent service, rapid transit, cleanliness and comfort, creates for itself a traffic which could not be attained by steam, horse, or cable systems.

The question of adoption or rejection of a lighting or traction scheme usually crops up at some time in the history of local authorities, and while such bodies are no doubt composed of good business men, it is hardly to be wondered that the discussion of a highly technical subject brings about much hesitation, and often results in adjournment of the matter.

The question of electric lighting at the present time is, of course, easily discussed from its commercial aspect, a plentiful supply of data being available to prove success, and no town of importance is to-day without its electricity supply, while many others have the matter under consideration.

It is reasonable to conclude, in virtue of the success met with by electric traction since its introduction, that its adoption will be equally general in a comparatively short space of time.

In many towns the tramway system is the property of the municipality or governing body of the "running area," the working of the line being leased to a private company.

Several municipal bodies are at present turning their attention to the question of tramways, and in the majority of cases the expiry of the lease (if the company be not previously bought out) will be followed by municipalisation and electrical equipment of the tramway system.

Perhaps another reason for the comparatively slow progress of electricity in this country is to be found in the fact that certain parties have anticipated results inimical to their own private interests, and have therefore endeavoured, as far as possible, to oppose its introduction.

In the case of the tramways, Board of Trade restrictions have no doubt retarded development somewhat; but on the other hand, we must bear in mind that in their priority, our Yankee brethren have given us the benefit of their varied experience, and we no doubt have benefited thereby.

Thus hardly any of the troubles which beset the early experimenters have been met with in this country, and it is gratifying to find that those tramway systems which have been electrically equipped, have almost without exception met with unqualified success.

Up to the present the only electrical system which may be considered thoroughly satisfactory, physically and commercially, is that of the overhead trolley.

Certain objections may be raised against this system, among them that which we are prone to hear on the grounds of æstheticism.

It seems hardly worth while to give the question serious consideration from this point of view, because, after all, our cities can hardly compare favourably with those on the Continent where the trolley system is largely in vogue.

Indeed, it would be hard to find a town in Great Britain which does not, in some way, outrage æstheticism to a much greater degree than could possibly be brought about by the introduction of a number of poles of ornamental design, carrying two wires barely $\frac{3}{8}$ inch in thickness.

The fact of the rails being employed as a return in the overhead system is sometimes urged as an objection on the score of electrolytic and other troubles, arising from earth leakage.

In practice, however, such currents are negligible, and easily preventable by careful observation of the Board of Trade tests.

To these the author will refer at greater length below.

The commercial success of the overhead system is assured, and where the conversion has taken place, increased traffic, and decreased working expenses have been the direct result. Moreover, as the system is extended, the working expenses decrease still further in proportion, which can hardly be said for horse or steam systems, though no doubt true for a cable system.

Let us consider, for a moment, the present status of electric traction in Great Britain.

There are at present some 30 tramway or railway systems actually at work by electric traction, and nearly as many are in progress.

If we include light railways schemes, which will no doubt employ electric power, no less than 80 tramways or railways are projected.

Of the tramways already installed, nine are owned by municipal bodies, the remainder being due to private enterprise.

The total mileage (of single track) is probably about 260, and this represents the total to date for the United Kingdom.

As was recently pointed out by Mr. Garcke, the corresponding total for America now stands at over 20,000 miles, while in Massachusetts alone, with a population less than that of Yorkshire, the tramway mileage exceeds that of the United Kingdom.

In the case of a town where a lighting supply already exists, and the question of power supply for trams is under consideration, a combination of the two naturally suggests itself.

It is to this feature of *combined supply* that the author desires specially to refer, subsequently entering into detail regarding the equipment of the station, particularly with reference to traction.

The artistic descriptions with which we are favoured from time to time by the Technical Press, contemporary with the inauguration of new stations, cannot obviously enter into details, and still retain their completeness.

Such a description the author proposes to supplement, and he trusts that his short series of articles may be acceptable to those of his colleagues throughout the country, and others, who may not have the opportunity of rendering themselves conversant with the practical working of a tramway power station.

In the consideration of a tramway scheme for an area within which a lighting station already exists, the question of power supply often entails considerable discussion.

That is to say, should the municipality (or company) erect a distinct power station, or should they, provided a suitable and sufficient supply be available, purchase their current from the already existing supply station.

This is a matter largely dependent upon local conditions, but there is no doubt that, particularly in the case of smaller stations, a tramway load would be most acceptable, while, at the same time, the cost to the tramway promoters would probably be less than the expense incurred by the building and equipment of a distinct power station?

"Combined lighting and traction stations" has already formed the subject of various papers which, together with the discussions thereon, form interesting reading.

To these the author may have occasion to refer later, but to anyone desirous of going into the matter at length, he would commend individual study of the proceedings of the Municipal Electrical Association.

The precise nature of the advantage accruing to a combined station, it appears to the author, is not generally realised, for on the one hand, we find the value of a tramway load often over-estimated, as regards its influence on the load factor, and on the other hand, greatly under-estimated on account of the concurrence of peaks on both lighting and tramway load curves.

In his recent work on "The Commercial and Business Aspects of Municipal Electricity Supply," Mr. A. H. Gibbings gives a concise yet clear summation of the question:—

"A great deal of importance has been attached to electric traction as a valuable factor in the day load output for the electric light machinery.

"No doubt it is, and will be for some little time to come, a valuable help in increasing the works load factor.

"But the demand for electric light is extending very rapidly, and must ultimately assume such proportions, that the maximum power required for electric traction will soon sink into insignificance in comparison."

It is the intention of the author to submit actual load curves for lighting and traction, which will show clearly the relation existing between them under ordinary conditions.

By so doing he hopes to succeed in showing precisely how much, or how little, importance should be attached to a tramway traction load regarded as a day load of a lighting station.

(*To be continued.*)

ENGINEERING CONFERENCE.

Separate Condensing Plants.

The papers on mechanical subjects before this year's Conference have not been of any particular merit. Sir Alfred Seale Haslam presents a paper on "Separate Condensing Plants." He reminds us that condensers date from the time of Watt who took out a patent for an injection condenser. This is hardly correct. Separate condensers were Watts's invention, no doubt, but previous to his time condensation was carried out in the steam cylinder itself, and the separate condenser was the first step in the system of compound working. Watt, in fact, began the division of the range of temperature in any one vessel, which has proved so great an aid to economy. In factory work, large engines are usually made condensing, but small ones exhaust to air. The application of a condenser, common to a large number of engines, has been found to secure an economy of 20 to 30 per cent., and on board ship this is a serious item, especially as the condensed steam is so valuable as boiler feed. The author does not think much of the ejector condenser, for he thinks it uncertain in action, and only capable, as a rule, of giving a vacuum of 14 to 18 inches of mercury. We have, however, known them to do much better than this. Surface condensers were invented by Samuel Hall, of Basford, Notts., in 1840, and first applied to the *Hercules*, a steamship plying between Cork and Liverpool, but they were but slowly taken up, and, in fact, were seriously opposed by marine engineers. The author considers condenser tubes are best fixed to their tube plates by the screwed gland system, and the tubes may be either copper or brass indifferently if tinned. A precaution is necessary with surface condensers to prevent the steam short circuiting through the condenser instead of playing over all the tubes. In the case of a Davy safety motor which came under our own observation, we found the introduction of a sheet iron spreader to deflect the steam over the whole space of the condenser to convert a failure into a success. The vacuum may be impaired 5 or 6 inches, says the author of the paper, if this precaution be neglected. In the case we cite from our own experience this was so. The evaporative, or open air surface condenser, is not new, as many suppose. It was patented by the author's firm 40 or 50 years ago, and used in some London sugar refineries by Messrs. Pontifex & Wood, who used 4-inch copper tubes at first, but later they found 2-inch pipes far better. These condensers use about $\frac{1}{10}$th the amount of water used by an ordinary surface condenser.

It is most important in all these condensers to have good joints, for, being exposed to the air, they are apt to leak inwards much air and vitiate the vacuum thereby.

Traction Power.

Mr. Thomas Parker discussed tractive powers in his paper, with, of course, especial reference to electricity. He presents a table of costs showing the total per car mile for different systems to be:—For horse traction, 7·78; steam, 8·99; cable, 4·40; electric overhead, 3·157; and Liverpool elevated, 4·316. Horse traction, objectionable and unsanitary as it is, is overlooked by the public as such. Suppose, however, that we had all been brought up on electricity, we wonder how the public would have greeted the introduction of an animal or travelling manure factory as a means of traction. Yet to hear some people object to electrical working is to convince us that many people really have no powers of observation. As to steam traction it is nearly as bad. The sulphurous fumes from the chimney, the dust and ashes, and the noise constitute a real nuisance, and we have just travelled behind a steam tram engine with pressure up to 200 lbs. per square inch, and that in old boilers. It is just this boiler question which makes steam traction so dangerous, apart from its unsightliness. Compressed air is, in a sense, better, but it can never do much better than steam, for even compressed air must have some kind of a fire to enable any sort of efficiency to be secured. Mr. Parker points out how very active are the air people at present. They have a field for compressed air, but it is not on regular tramway work though it is supposed to be cheaper than steam.

Cable traction, we are told, has the drawback of heavy initial outlay, and there is also the noise of the running cable. The system is unsuitable for light traffic, and the breakage of the cable is so serious in its consequences that cable roads have never done very much in gaining the general confidence of the public. The author cannot say much of gas traction in the absence of reliable data. Personally, we think there is something in it for limited conditions, but its friends ought to spend more of their energy in putting a stop to the leakage which places passengers in an atmosphere of gas.

Electricity alone is, by general accord, selected to-day as the motive power for tramways and light railways. It is flexible as regards wide variations of powers at different parts of a system. It has no nuisances like horses, steam, or gas. The cars occupy a minimum space on the road and speed is low or high as desired. It interferes as little as even horse traction with the road surface. A certain disadvantage is attached to the overhead conductors, but they are at present the only means of distribution available, at least on an unenclosed line, and have been accepted by all except a few very perverse local authorities. Accumulator traction is dismissed with very few words. It costs 4·6 H.P.-hours per car mile as compared with 2·15 E.H.P.-hours with overhead conductors, and this, too, on an easier road and at a less speed. For railway work electricity shows best on long runs and with a crowded traffic. Thus from London to Brighton electricity could give a 15-minutes' service, run at 75 miles per hour, and do the 50 miles in 40 minutes, with 100-ton trains at 2½d. per train mile for power. The track would be cheaper, and risk and maintenance would be reduced. The Liverpool overhead line is not a favourable one for electrical working, yet it shows well in comparison with steam lines, and it has run seven years.

Mr. Parker has something to say of motor cars. For the present we think, as regards electric motor cars, much cannot be said if the motive power has to come from accumulators. Nor do we think much of steam or compressed air or even of compressed gas, for the latter cannot be got anywhere. The best accumulator is a can of benzoline. We have looked at all sides of the motor car question, and we do not like the smell of the benzoline car too much, but it is better than horses. The car is easier managed than steam, and it is the one car at present available for the private citizen. Electricity is not at present available—we except electrical vehicles on the smooth pavements of London for various reasons, one being the ease of charging up. But generally the oil car is the one for the private user, and we are glad to see so many neat little phætons at work. As regards electric accumulators, however, it may be pointed out that the cell of 5 cwt. will to-day do what required 16 cwt. of cells two years ago, and 1 H.P. can be had for 56 lbs. weight of cell. Thus a car of 9 cwt. with 5 cwt. of batteries or 14 cwt. in all will carry four passengers at 9 miles per hour for 40 miles. The discharge will be 12 amperes at 80 volts on the level with a motor at 1,200 revolutions and double reduction

gear. With such figures a few more charging stations will increase the chances of success for the electrical motor car.

Machine Tools.

Mr. Arthur Greenwood compared English and American and German machine tools, and upheld the flat bed in place of the V for planing machines. Flat beds are superseding V beds, even in Germany and America, where they have been so much considered. Americans prefer rack driving to our screw system and get good results. They also use very quick return strokes though this wastes a lot of power as can be seen by watching the ammeter of an electrically driven tool. Yet probably the saving of time is worth paying for. Americans still adhere mistakenly to V beds on lathes. True, these allow the saddle to move a little more easily, but for heavy cuts this advantage is lost, as the carriage must be weighted or held by a lip, otherwise the cutting tool will run in, the V bed allowing movement. Generally the English lathe is superior, and in milling the English tool takes the lead. America has been to the front in automatic tools, but there is now rapid movement in both England and Germany in the same direction. It is in repetition work that America has done so well. There is not much repetition work on large marine engines, and England, we may point out, leads in these. America has studied automatic systems and is reaping an advantage to-day in all classes of small and light work, and also reaps an advantage in the fact that her manufacturers of tools confine their energies to one tool. One man makes a lathe, another makes drill presses only, and so on, and each excels in his line. English tool makers have been too diffuse, but one maker should not attempt to know too much. It is a mistake, and we ought to copy America in this.

What is a Light Railway?

This paper, by Mr. A. C. Pain, is a plea for standardising the light railway practice of the country and reducing the number of gauges to which such lines should or may be constructed. There are now such gauges as 3 feet 6 inches, 3 feet 3½ inches, 3 feet, 2 feet 6 inches, 1 foot 11½ inches, and even 1 foot 3 inches. Such minute differences cannot be necessary, and are a heavy tax on manufacturers of all kinds of equipment, and more or less directly therefore on all railways.

The author very sensibly says "do not build a light line with a view to making it heavier in the future." Such a plan spoils the line. Build the line to 2 feet gauge if this seems correct, and, when the time comes, sell the materials and reconstruct completely.

The construction with an eye to future widening can rarely be a wise proceeding. It is advised, then, to standardise narrow gauge to two types, say, 3 feet and 2 feet. Granting these gauges, or, perhaps, better still, 3 feet 6 inches and 2 feet, the mileage of narrow gauge lines would increase rapidly. With only two gauges, and these legalised, there would always be a sale for materials when a line came to be altered, and there would always be standard rolling stock and station equipment to be bought from manufacturers at a minimum price, being made cheaply owing to its being standard and therefore made on the best and cheapest system of repetition work. We are inclined to think that one of the reasons for the slow progress of light railways has been the impossibility of constructing and working such lines to standard gauge, and the mistaken idea that this standard gauge was necessary. Re-handling at stations when transferring goods to the standard lines is, of course, to be deprecated, but it does seem to us that a light feeder line could be very readily arranged, so that goods could be transferred by cranes, which would lift platforms bodily from flat-bodied trucks in the same way that is adopted in the textile districts for unloading huge piles of cloth, which are loaded upon drays which carry a loose platform, and this is slung off by a four-hook chain direct to the railway waggon with little loss of time.

The question to consider is not altogether which is the cheapest way to work, but whether by means of a light railway in a sparsely populated country a saving can be effected upon the existing cartage methods? It will be found that first cost is really a more important item than it appears to an actuary who would capitalise the subsequent costs and, perhaps, prove the more costly line to be the cheaper in the long run. In ordinary business a man often hires machinery which he cannot afford to purchase, and is thereby enabled to do work he would not touch but for this hiring. We do not ask this man not to attempt such work. He makes so much profit and pays half of it away in hire of plant. But if he did not hire the plant he would not even make the half profit. So with light railways. Their profits are partly paid away in working costs, and if they had been built at greater cost they might have made better profits, but the capital is not available for such larger initial cost. As we have before stated, light railways must be worked at moderate speeds; their purpose is to serve people who have gone in slow carts or have walked, and speed is not essential, and with slow speeds there is at once abolished the huge cost of signals and other safeguards necessary at high velocities.

A great advantage of standardising our light railways would be that in case of war, the army could be promptly supplied with any amount of railway material, following up the advance of an army, and greatly reducing the expense and time.

Among the papers were two by Prof. W. E. Ayrton and Mr. R. A. Hadfield respectively, which bear closely on subjects to which we have recently given much space. In Section 7 Prof. Ayrton raised a whole series of questions on the properties of materials used in electrical instruments, while in Section 4, that of mining and metallurgy, Mr. Hadfield dealt with the importance of the temperatures employed in manufacturing steel. Mr. Hadfield's point of view was not, of course, that of the electrical instrument maker, but few aspects of modern engineering are more interesting than the way in which observation and research in one branch tend to act upon others with which, at the time, they may not appear to have the remotest connection. Accurate measurements of furnace temperatures are now made with two purely electrical instruments, the thermo-couple and the resistance pyrometer, and the electrical effects on which the actions of these depend were studied originally without the slightest idea of their very important applications to metallurgy. Refined methods of working steel now enable steel makers to repay this debt to the electricians by giving them steel and iron of enormously better quality than were obtainable a few years ago.

In opening these discussions at the Engineering Conference, the object in view was to propose to the audience practical questions which might give opportunity for comment by succeeding speakers, and so elicit information and discussion. These papers are statements in outline of the existing conditions of knowledge and practice in some engineering problem, and indicate its nature and practical importance. They are not intended, we understand, to be contributions to science, or to propose solutions of problems. Mr. Hadfield's paper emphasised the importance of closely observing the temperature in casting steel, and gave tables of temperatures of the melting points of several important substances, and of different kinds of iron and steel. Mme. Curie, in her recent important paper on permanent magnet steel, of which we published a very complete abstract, commented on the importance in manipulating magnet steel not to heat it much above the critical temperature, or point of recalescence. This temperature is in the neighbourhood of 750° C. When it is remembered that the steel has already been cast at a temperature over 1,400° C., and rolled at a temperature not much below 1,000° C., it seems clear that the importance of regulating these latter temperatures must be great, when a subsequent overheat in the neighbourhood of 800° C. may be injurious.

Prof. Ayrton's paper in the electrical section, which we print in full elsewhere, referred to a number of the materials used in electrical work, and to instruments constructed with them. The recent improvement in the conductivity of commercial copper, which can now be obtained in the ordinary way of trade 5 per cent. above Matthiessen's laboratory standard, is well known and of great importance, but we do not see a prospect at present of any considerable further improvement; especially in view of the point to which Prof. Ayrton called attention, viz., the possibility that the higher conductivity already obtained is due to different molecular arrangement more than to greater chemical purity. The second point raised, viz., the relation between the temperature

coefficient of a conductor and its chemical constitution promises interesting development in the near future. We know of no systematic study of this subject since Matthiessen's (published in 1860—62), and it would seem that his curious law, which determines the temperature change of most bi-metallic alloys, might be expected to form the foundation of further and fruitful research. The law stated that the change of conductivity of bi-metallic alloys between any two temperatures can be calculated as if the alloy was a mere mixture; or as if the materials were formed into separate wires connected in parallel, instead of being alloyed; but that the conductivity itself (except in the case of certain metals) is very much less than the sum of the conductivities of the alloyed constituents. This appears to indicate, and experience confirms the indication, that the actual change of resistance with temperature of a wire of given size is not a quantity we can greatly hope to reduce, and that we can only reduce its importance relatively to the whole resistance of the wire by selecting an alloy whose specific resistance is high. To show how widely Matthiessen's rule may be roughly applied, even beyond the range of his experiments, the following table gives the approximate figures for three different metals:—

1,000 feet of wire 4 mils. diameter.	Resistance at 0° C.	Resistance at 100° C.	Increase between 0° C. and 100° C.	Percentage increase per degree.
Copper	600	858	258	·43
Platinum-Silver	9,000	9,279	279	·031
Platinoid ...	12,500	12,725	275	·022

The increase of the temperature coefficient of commercial copper concurrent with the improvement in its quality, noticed recently by Messrs. Clark, Forde & Taylor, is in the same direction. The discovery of such high resistance alloys as Manganin and Eureka, in which the coefficient is very small, or negative (that of Eureka is —·006) is anomalous, but in some way or other a high conductivity seems to be irreconcilable with a small temperature coefficient, and Prof. Ayrton's suggested search for an alloy possessing both of these two desirable qualities seems anything but hopeful. The most promising route open at present to discoverers in this region seems to be along the lines of Lord Rayleigh's speculation that resistance is due to electromotive forces of contact between the molecules of the different constituents.

The demand for a metal having the elastic properties of quartz for the strips of suspended coil galvanometers and electrometers may be met to some extent almost any day; but the commercial value to a metallurgist of the extremely small quantities required could not well repay research for that immediate purpose. The desired discovery may perhaps come as a bye-product of another investigation.

Prof. Ayrton's observations on the present limitations of suspended coil instruments and of the difficulties attending the use of electrostatic voltmeters, come from the most accomplished and persevering worker in these particular subjects, and indicate the direction in which the present designers look for improvement in switchboard instruments.

Electrical Transmission, Transformation, and Distribution.

The two papers read by Mr. Swinburne and Mr. Parshall before the section which deals with Applications of Electricity, introduce subjects of great interest and importance to electrical engineers; the one treating of "Methods of Electrical Transformation," and the other of "Transmission and Distribution of Electricity from a Distance." Mr. Swinburne includes in transformation all the processes between the power house and the consumer, so that the two papers overlap very much, and might with advantage have been set down for reading on the same day so that they could have been discussed together. Mr. Swinburne compares four methods, direct current and single-phase, double-phase, and triple-phase alternating currents; and whilst allowing that the method in fashion just now is to generate triple currents and transform them into direct currents for distribution, he appears to think that the direct current method, at any rate for moderately high pressures, deserves more consideration than it is at present receiving.

His remarks about following the fashion may well be taken to heart, for there is too great a tendency to leave out of consideration the special conditions which may have justified the use of a particular system in one case, and to blindly follow the lead in another where no such special conditions exist. For instance, because three-phase currents are best suited for some transmissions at extra high pressure, that is no reason for using them for a town lighting scheme with a generating station at a moderate distance outside the area of supply; nor, because a dust destructor may have been a financial success in one town, is it any reason for putting the generating station of another town in an inconvenient and uneconomical position for the sake of getting a few pounds of steam without having to pay for the fuel to raise them! Again, triple concentric cables were found to have certain advantages in alternating current work which more than compensated for difficulties in jointing and making service connections, but we have never been able to find out why they were specified in certain cases for direct current mains.

The authors of both papers agree that as far as the generating plant is concerned there is not much to choose between the various methods, but neither of them mentions the different effects of load and power factors on alternating and direct current systems, which will be all in favour of the latter with an underloaded plant. The same remarks apply to the transforming apparatus when direct currents are to be delivered to the consumer; but where alternating currents are to be delivered, the first place must, as Mr. Swinburne says, be accorded to single-phase currents. The greater part of Mr. Parshall's paper is devoted to the subheading of distribution, and attention is specially called to the points which must be considered in fixing the number of sub-stations so as to balance up the lower efficiency of transformation, higher first cost of plant, and heavier attendance charges, against the smaller cost of mains and better efficiency of the same, which will result from an increase in the number of sub-stations. Mr. Parshall's paper shows that he follows the fashion, or perhaps we ought to say that he is one of those who have set the fashion of advocating multiphase transmission and direct current distribution; but it also shows, we think, that he has more in mind the problem of electric traction and power transmission over long distances than that of general distribution for light and power in towns or districts.

Mr. Swinburne draws special attention to the importance of the transmission mains, and shows for certain assumed conditions, that as regards economy in copper three-phase currents are best and direct currents next; but that as regards insulation the direct and single-phase currents take the first place. He is careful to state that in this comparison all questions of loss by dielectric hysteresis are left out of consideration, which is to be regretted, as this is a matter on which information would have been very welcome. In fact, the question of direct *versus* alternating currents turns very largely in many cases on the losses arising with the latter system from capacity and inductive effects. Mr. Swinburne complains of the insufficient attention given to the question of insulation, and seems inclined to be a little hard on the cable makers because he cannot find out what principles they work on. This difficulty arises in great measure, we think, from the fact that so few people, except the cable makers, give any intelligent attention to the subject; and it might perhaps be removed if the theory and principles of insulation were studied by non-manufacturers in the same way as those of the generating plant have been. It is most likely that they do not use the formula given by Mr. Swinburne, but we think that the present custom of making insulation resistance of secondary importance as compared with power to resist disruptive stress was initiated by the manufacturers; and we know that some makers will not recommend small insulated conductors for high pressure work, though we are unable to say whether this is from a knowledge of the law of stress distribution first pointed out by Mr. Swinburne several years ago, or from the rule-of-thumb method of noting that small cables were more liable to break down than larger ones. The whole question of insulation, which is daily becoming more and more important with the tendency to use higher pressures, certainly

deserves more attention than it has hitherto received; and it would be a useful help to comparing different systems of transmission, if those who have had practical experience of the use of insulated cables, with direct and multiphase currents at high pressures, could tell us more about the relative stresses on the dielectric due to the same mean pressures.

LONDON COUNTY COUNCIL.

THE Council on Tuesday resolved to convene a special meeting to consider the question of applying to the Board of Trade for a provisional order to construct new and extend existing tramways in various parts of the metropolis.

LIGHT ELECTRIC RAILWAYS.

A long report was brought forward by the Highways Committee dealing with the negotiations with the Middlesex County Council on the subject of the construction of light railways in Middlesex. It appeared, from the report, that the Council for that county were not prepared to appoint members to serve upon a joint committee of the two Councils on light railways; that the Council intended to be the light railway authority for the county, and to own and then lease the proposed lines; and that the Middlesex Council were acting as joint promoters with the Metropolitan Tramways and Omnibus Company for the construction of five light electric railways in Edgware, Finchley, Hendon, Highgate and Whetstone. The Highways Committee, finding that it was unlikely that the Middlesex County Council would co-operate on a joint committee, recommended that no further action should be taken in the matter.

The Earl of Onslow asked whether the electric lines proposed by the company were identical with those suggested by the Finchley District Council for Finchley and Hornsey, and referred to in a further report by the committee.—Mr. J. W. Benn replied that in so far as those two districts were concerned the lines were identical schemes. It would be for the Light Railway Commissioners to decide whether the orders should be granted to Mr. Godfray and the Middlesex County Council, or to the London County Council, supported by Finchley and Hornsey.—Earl Russell contended that under the Light Railways Act the County Council had full powers to extend the tramways outside London.—Mr. Beachcroft denied that the Council had that power. In his opinion the Light Railways Act made it perfectly clear that the County Council could not construct tramways outside the county without the consent of the external County Council or the special sanction of the Board of Trade. After a long discussion the recommendation of the committee was adopted.

The Highways Committee further reported that the Finchley District Council had deposited a scheme for light railways within its district, and had asked the Council to support it, and to seek in conjunction with the Hornsey Council for powers to extend the existing tramways from the terminus at the Archway Tavern, Highgate, and to join on to the Finchley light railways at the Hornsey boundary. These schemes, which are those already referred to by Lord Onslow, were again discussed at some length, the opponents contending that it would be inadvisable to oppose the Middlesex County Council by supporting the District Councils. It was, however, eventually decided to authorise the Highways Committee to negotiate with the Finchley and Hornsey Councils with a view of the light railways being extended so as to join the Council's tramways at the Archway Tavern, Highgate.

SUPPLY OF ELECTRICITY IN BULK.

A further report by the Highways Committee referred to the Bills introduced last year for the supply of electricity in bulk. In connection with those Bills a Joint Committee of both Houses of Parliament was appointed, and the following paragraph is taken from the Joint Committee's report:—"It is to be observed that the exemption from liability for compulsory purchase would not prevent local authorities, either alone or in combination with other authorities, from applying for power to purchase, but each case would have to be judged on its merits, and such conditions imposed as might be thought fit."

In commenting on the position of affairs the Highways Committee said:—

> We have carefully considered the matters connected with the supply of electricity in bulk, and are clearly of opinion that, having regard to all the circumstances, it is desirable that the Council should have power to purchase undertakings established for that purpose; but we do not for a moment suggest that the Council should in any case prevent or impede the exercise by each local authority of its existing powers of purchase under the Electric Lighting Acts, which, indeed, we think the Council should take every possible means of preserving intact. These powers are, however, only exercisable by a local authority as regards undertakings situated within its own area; and it might happen that, the generating station for the supply of electricity in bulk to several areas having been purchased by the local authority in whose area it was situated, and which authority would take the place of the supplying company, the other local authorities concerned would be dependent upon that authority for the supply for their districts. The possibility of such a case as above stated, which it is not at all unreasonable to assume might arise, appears to us to show clearly the desirability of the Council having power to purchase, with the concurrence of the local authorities concerned, generating stations used for supplying electricity in bulk in London. The chairman of the House of Lords Committee on the Metropolitan Electric Lighting Bill of last year, in announcing the decision of that Committee on the application made by the Council for clauses to give effect to the resolution of the Conference, referred to the above paragraph in the report of the Joint Committee, and stated that the Committee considered that they could not with advantage attempt to put a purchase clause into the Bill, and that the Council could, if it so desired, proceed upon the resolutions by promoting a Bill to confer upon it powers in respect of the purchase of "bulk" generating stations and other works connected therewith. That there seems to be no other way of attaining the Council's object than by fresh legislation appears clear from the fact, reported by the Parliamentary Committee to the Council on March 28th, that the Central Electric Supply Bill, the object of which is to enable a new company to supply electrical energy "in bulk" to other companies and to local authorities, had been passed by the House of Commons without the insertion of the provisions asked for by the Council, reserving to it powers to purchase the undertaking. The Council has presented a petition to the House of Lords with the view of obtaining some satisfactory arrangement with respect to purchase of the undertaking to be authorised by the Bill. The solicitor states that, having regard to the fact that the Council is not the local authority in relation to electric lighting, he has come to the conclusion, although the question may not be free from doubt, that the Council has no power to spend money in promoting legislation in the direction indicated. We are considering what course should be taken with reference to the matter in view of all the circumstances, and hope to be in a position to report upon it at a later date.

It was decided to suspend the standing orders, so that the Highways Committee might submit a proposal for an application to Parliament on the subject.

VARIOUS MATTERS.

The Council approved a new design of transformer box submitted by the County of London and Brush Provincial Electric Lighting Company. The width of the box is 4 feet 3 inches to the outside of the metal, as compared with 5 feet 6 inches in the old design. Approval was given by the Council to a modification of the terms of the resolution passed on May 16th, relating to the London United Tramways. The alterations provides for the inclusion of more streets in the scheme for the introduction of an underground system of electric traction.

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from page* 956.)

31. After weighing all the evidence carefully, the Committee are of opinion that a deduction of 33 per cent. from the theoretical speed is amply sufficient to give the practical speed, or the paying traffic.

32. This estimate is a cautious one.

33. There is no apparent reason why, with good management, the "dead" traffic on a Pacific cable should not be kept much nearer to the level which obtains on the Atlantic than to that which obtains on the Eastern lines. In addition, however, must be taken into consideration unavoidable losses of time in each working hour, and the fact that the use of code words (usually long ones) is increasing.

34. It has also been stated in evidence that possibly a Pacific cable would have to comply with the regulations of the International Telegraph Convention, but in the case of a line touching only British territory this necessity may perhaps be avoided.

35. The estimate of 33 per cent. has been arrived at with the desire to include an allowance for every possible deduction from the earning power of the cable.

If the experience of the Atlantic cable companies can be relied on the percentage would be considerably reduced.

Number of Working Hours per Diem.—36. In this matter, again, the expert evidence was somewhat conflicting, but the Committee consider that an estimate of 18 hours per diem during which the cable could be worked would be a moderate one. A very small allowance for duplex working has been made in this calculation.

37. Duplex working is the system under which the same cable is made to transmit messages from both ends at the same time. It can be applied so as to add about 80 per cent. to the traffic sent by simplex working. But full advantage can only be taken of this system when the business hours are substantially the same at both ends of the cable. This, for instance, is the case between, say, London and Lisbon: as between London and New York, where the difference in point of time is about five hours, duplex is only regularly available for the few hours which may be considered part of the working day in both places: while as between this country and the east of Australia, where the difference is about 10 hours, so that night here is almost synchronous with day there, duplex working would only be resorted to to a small extent.

38. The conclusion the Committee have arrived at is that the core of 552 lbs. copper and 368 lbs. gutta-percha might reasonably be expected to give 40 paying letters a minute.

39. The core of 650 lbs. copper and 400 lbs. gutta-percha similarly would give 48 paying letters per minute.

40. To get the carrying capacity of these cables in a year the above numbers of letters should be multiplied by 60 (minutes to the hour); then by 18 (working hours per day); then by 300 (working days in a year). The totals on this basis would be:—

At 40 paying letters, or 5 paying words	...				1,620,000 words.
At 48	"	"	or 6	"	" ... 1,944,000 "

41. Thus the lowest of these totals considerably exceeds the whole of the Australasian traffic in any year except 1895.

Cost of Laying.—42. The India-Rubber, Gutta-Percha and Telegraph Works Company has offered to lay the whole cable over the route recommended, with the first of the above-mentioned types for the long section, for the sum of £1,517,000, this sum including the erection at each station of a suitable dwelling-house and operating room, with duplicate sets of all proper instruments; also the use of two cable repairing ships, with the cost of maintaining them as well as the cables themselves for three years.

43. This estimate included an allowance for 10 per cent. slack.

44. This allowance of slack is, in the opinion of the Committee, a reasonable one for actual laying, but they are of opinion that another 10 per cent. should be manufactured, which would be properly

chargeable to the repair and maintenance fund to be hereinafter mentioned.

45. The condition as to maintenance for three years was laid down by the Canadian Government in inviting tenders, but though there is some convenience in thus having maintenance guaranteed for the first three years, the Committee consider that such a period is unnecessarily long as a test of the original condition of the cable when laid, without being long enough to prove its durability while under water; and they would recommend that the contractors should be required to maintain the cable for six months. With this modification the price would presumably be varied in approximately the following manner:—

	£1,517,000
Deduct cost of maintenance for three years; this was put at £40,000 a year for the two ships, and £30,000 a year for the cable used	210,000
	£1,307,000
Add for maintenance for six months at the same rate	35,000
Add for purchase of two repairing ships ...	80,000
	£1,422,000

or in round numbers, and leaving a margin of £78,000 for miscellaneous expenses payable out of capital, £1,500,000.

46. It seems probable that another firm would offer similar terms.

47. As regards the probable cost of a cable of the second of the above types, the information laid before the Committee is to the following effect:—

48. The Telegraph Construction and Maintenance Company estimated that the price for such a cable from Vancouver to New Zealand *vid* Honolulu would be £1 870,000; this sum including the cost of five stations, estimated at £37,000. This distance (without slack) would be 6,352 nautical miles, and the longest span (Vancouver to Honolulu) 2,325. The route recommended is (without slack) 7,186, and the long section is about 3,200. The price of this type, therefore, on the basis of the above estimate, would considerably exceed £2,000,000.

49. The India-Rubber, Gutta-Percha, and Telegraph Works Company stated, in reply to a question from the Canadian Government, that their price for a 15 word per minute cable would be £1,672,000, and for 18 words £1,880,000; but specifications for these cables have not been given.

50. The representatives of the Eastern Extension Telegraph Company estimated the cost of the cable, with a core of 650 lbs. of copper and 400 lbs. of gutta-percha between Vancouver and Fanning Island, allowing 15 per cent. or more for slack, and including the cost of erecting stations and supplying apparatus, at about £1,650,000. The Henley Telegraph Works Company tendered for a cable of this type, with completely equipped and furnished stations and cable huts, for £1,492,000.

51. Mr. Preece also estimated that a cable, of a heavier core over the section to Fanning Island (800 lbs. copper and 550 lbs. of gutta-percha), would cost a little over £2,000,000. It seems therefore possible that a cable of the dimensions under consideration might be had for £1,800,000. It would not be prudent to put the whole capital required for such a cable at less.

Working Expenses.—52. The annual working expenses at the stations on the line may, the Committee consider, be put at £17,000, having due regard to their position and the cost of living.

53. For the central management £5,000 is allowed, making a total for annual working expenses of £22,000.

Maintenance and Repairs.—54. With regard to maintenance and repairs, it is of course impossible to forecast what interruptions would occur in any year and what expenditure would be incurred in restoring communication. It may, however, be remarked that repairs of a cable are the substitution of new material for old; so that in course of time the whole of the cable might be replaced; and this circumstance affords some guide as to the annual sum which should be set apart, on the principal of providing, not merely for the cost of annual repairs in case of interruption, but for the entire replacement of the cable, so far as might be found necessary, within some definite period. Thus the replacement of the cable would be completed in 40 years by laying 200 miles of cable a year; and taking the cost of cable, in round figures, at £200 a mile, this process would, on that basis, be effected by devoting £40,000 a year to this purpose. It is not suggested that it would be necessary to replace every part of the cable in such a period, or that such a sum would be expended each year on repairs; but the fact that the sum named would not only meet current repairs, but would in 40 years be equivalent to the replacement of the whole cable, indicates, in the opinion of the Committee, that it is as great a provision as need be made under this head. To it, however, should be added the fixed expenses of two repairing vessels, which may be put at £30,000, making £70,000 in all.

55. It should be added that the evidence clearly shows that the great depth of the Pacific will be a favourable factor in determining the life of the cable, while it will be an unfavourable influence on the facility and cost of the necessary repairs.

56. The provision suggested would therefore, it is estimated, in the shape partly of new cable and partly of unexpended balances, perpetually maintain the value of the cable as an asset.

Total Annual Charge.—57. To the expenses of working and maintaining the cable must be added the annual charge for interest, and provision for replacing the capital at the end of a certain period.

58. Having regard to the character of the work, the Committee think that a period of 50 years might reasonably be allowed for the latter purpose.

59. The rate of interest to be assumed must depend to a great extent on the conditions under which the capital is raised; and the Committee have therefore thought it better to append four estimates of the total annual charge which must be provided for, varying according to the type of cable selected and the rate of interest.

60. In each case the sinking fund is calculated to replace the capital in 50 years.

	With a capital of £1,500,000.		With a capital of £1,800,000.	
	Interest at 2¾ per cent.	Interest at 2½ per cent.	Interest at 2¾ per cent.	Interest at 2½ per cent.
Interest	£41,250	£37,500	£49,500	£45,000
Sinking fund	14,311	15,387	17,173	18,464
Working expenses ...	22,000	22,000	22,000	22,000
Maintenance	70,000	70,000	70,000	70,000
Total	£147,561	£144,887	£158,673	£155,464

61. The Agent-General for South Australia, under instructions from his Government, placed before the Committee the claim of that Government to be compensated for the loss which they will sustain by the diversion of traffic from the line of telegraph which they erected across the continent of Australia, and over which a considerable proportion of the traffic now passes.

62. A somewhat similar claim may be put forward by the Eastern Extension Telegraph Company in the event of a cable being laid across the Pacific with Government assistance. No question of compensation has been referred to the Committee, and they therefore abstain from expressing any opinion upon the equity of any such claim.

63. The Government of India, whose position is in many respects similar to that of South Australia, have intimated that they do not propose to make any such claim.

IV.—REVENUE.

64. The revenue depends on the amount of traffic obtained, and there are no certain data by which this can be calculated. The representatives of the Eastern Extension Telegraph Company and Mr. Lamb, of the General Post Office, estimated that, on the total traffic of 1895, the amount which would be diverted to the new cable would be 672 297 and 620,000 words respectively. Mr. Sandford Fleming, for the reasons given in his evidence, put it at one-half the existing traffic. The Committee having considered all the evidence bearing on the subject, and feeling that they must in such a matter be actuated by extreme caution, select 750,000 words (which are between a third and a half) as a basis of calculation for the year 1896. They further consider that the estimate may assume an annual increase of this traffic at a rate of 10 per cent. In 1875 the amount of the Australasian telegraphic traffic was 235,160 words; in 1885 this had risen to 537,355 words; and in 1895 to 1,860,423 words. Thus the estimated rate of increase is considerably below the ascertained average increase of recent years; but special caution is advisable in drawing an inference from this, as the increase has lately been out of proportion to the increase of business so far as shown by imports and exports, thus probably indicating a change of habit in transacting commercial business which must have some limit, and further, the rather special circumstances of the Western Australia gold discoveries must be taken into account. There are no materials for estimating the probable increase in the American-Australasian traffic, which is at present very small, but it is likely that with a Pacific cable it would substantially develop. A little local traffic in the Pacific may also be counted upon.

65. These circumstances appear to the Committee to show the moderation of their estimate, but they have not failed to bear in mind the fact that the Eastern Telegraph Companies possess an old-established business, with wide connections, and that if any prolonged breakdown occurred on a Pacific cable, great injury might (in the absence of a duplicate cable) be inflicted on its business. On the other hand, the Atlantic Cable Companies in England would be interested in collecting traffic for a Pacific cable.

66. The amount of the through rate would depend on the terms made with the trans-Atlantic companies and the American landlines, but the Committee have been informed that a shilling rate could be obtained from Great Britain to Vancouver.

67. Taking, however, the existing rate to Australia of 4s. 9d. a word as a basis, and assuming that the existing rate of 1s. 6d from London to Vancouver is maintained, a Pacific cable would be able to secure 3s. 3d. a word. On an estimated traffic of 750,000 words in 1896, this would amount to £121,875. If the tariff were reduced so as to admit of a Pacific cable retaining 2s. a word, the revenue would be £75,000, and at 1s. 6d. a word, £56,250. This calculation is based on the assumption that each word pays the full rate. No reduction is made for Government or Press telegrams, because allowance for this consideration has been made by the Committee in arriving at the above estimate of the total traffic, and after reckoning that similar proportions of Press and Government telegrams would be carried by a Pacific cable, and at similarly reduced rates to those now transmitted by the Eastern route. According to the returns of the Eastern Extension Telegraph Company for 1895, the press words were about 10 per cent. of the whole, and the Government words about 2 per cent.

68. The Committee have only to add, with reference to the financial question, that the cable would be a competitive line, and would have to be managed accordingly. While they have felt themselves

bound, as they have remarked, to show extreme caution in their estimates, they consider that the question of expenditure, and still more the question whether a business approximating more to the capacity of the cable could be obtained, would largely depend, as would similar questions in all industrial enterprises, on the energy and care shown by the management.

69. The evidence has clearly shown that the best management, and the adoption of the most improved methods, can get much more paying work out of a cable than inferior management and the use of older methods.

Recommendation and Summary.—70. In consideration of the traffic estimated for the cable, and of the opinion expressed below, that a duplicate cable should be laid at the earliest possible moment, the Committee have arrived at the conclusion that a core over the long section from Vancouver to Fanning Island of 552 lbs. copper and 368 lbs. gutta-percha will be sufficient. On the assumption that this recommendation is adopted, and taking the total annual expenditure at £144,887, and the increase of business at 10 per cent. per annum on 750,000 words in 1896, a Pacific cable would, if it came into actual work on January 1st, 1900, earn £178,437 in its first year of working, if the rate obtained by it per word were 3s. 3d., thus leaving a credit balance on the first year's working of £33,550. If the rate per word were reduced to 2s., in the year 1900 it would earn £109,807; in 1901 £120,788; in 1902 £132,867; and in 1903 £146,153; it would thus become a paying concern during the fourth year of working.

V.—OWNERSHIP.

71. The Committee are of opinion that the cable should be owned and worked by the Governments interested.

72. In arriving at this conclusion, they do not underrate the importance of allowing all commercial undertakings to be carried out, whenever possible, by private enterprise unassisted by Government. But in the present case there seems to be no probability that private capital will be forthcoming for the purpose of laying a Pacific cable without a larger subsidy than the Governments interested in the project would be prepared to grant.

73. If Government assistance, in some form or other, is necessary, the Committee think that a scheme under which the cable would be constructed and owned by the Governments interested is much to be preferred to a private company working under a Government subsidy.

VI.—MANAGEMENT.

74. The Committee are of opinion that the general direction should be in the hands of a manager in London, under the control of a small board, on which the associated Governments would be represented. The manager would be in communication with the telegraph authorities of the respective Governments with regard to matters of local administration. The details could be arranged without difficulty by the Governments interested.

VII.—CONTRACT.

75. The contract would in the main follow the ordinary forms, specimens of which are shown in the Appendix. Provision should be made for a preliminary survey under the supervision of an officer appointed by the Governments, and for the maintenance of the cable by the contractor for six months, as recommended above. The cable in shallow waters should be protected by brass taping against marine insects. The details of the specification would present no difficulty when the type for the long section has been fixed upon, as there is not much difference between the present modes of constructing submarine cables.

Duplication.—76. The Committee have only to add that it would in their opinion be necessary to lay a duplicate cable, and that, if a deviation from an all-British route were permissible in the case of a duplicate cable, and if the circumstances of the time permitted of it, such a cable might advantageously follow a somewhat different route, *viâ* Honolulu. Most cables on important routes have been duplicated, but generally in the first instance they have been laid singly, and the duplication has followed when the success of the undertaking warranted a fresh outlay of capital.

77. There can be no doubt, however, that the duplication should be effected at the earliest convenient opportunity. Cables have usually been duplicated to protect and preserve their business in case of interruptions, even when there have been no competing lines ready to profit by their breakdowns. Duplications would be, therefore, the more necessary in the case of a new line, which would be laid in competition with an existing undertaking.

78. If a second cable were laid along the same route as the first, the annual expenditure entailed by it might be reckoned at £37,000 less than that of the first, as the additional working expenses would certainly not exceed £15,000, and there would be no additional standing charges for repairing ships. If a second cable were laid *viâ* Honolulu, not only would there be the above-mentioned reduction in annual expenditure of £37,000, but also a very material reduction in the charges for interest and sinking fund, as the capital required would be less.

79. In the event, therefore, of a second cable being laid along the route recommended for the first, and on the assumption that the tariff were reduced to 2s. a word, and that such a reduction brought no increase of business beyond the 10 per cent. per annum already estimated, the total annual receipts from the two cables would exceed the total annual expenditure upon them in the tenth year from the commencement of the work of the first cable in 1900. If a second cable were laid along the cheaper route, or if the tariff were not reduced to 2s. a word, or if the annual increase of business exceeded 10 per cent., the period during which the total annual expenditure exceeded the total annual receipts would be proportionately shortened.

80. Moreover, the financial position of the cables would be a very strong one.

81. The custom of the owners of cables is to put by such a sum of money every year as will enable their cables to be kept in continual repair, and the old cable entirely replaced by a new cable within a certain number of years. This they consider to be a sufficient provision for the replacement of their capital. The Committee have, however, suggested that in the case of a Pacific cable there should be what practically amounts to a double replacement of capital. They have recommended that a sufficient sum should be set aside for annual maintenance to ensure the complete renewal of the cable within 40 years, so that at the end of that time the associated Governments should either be in possession of a new cable, or, if the old cable had not been wholly renewed, of a reserve fund sufficient to replace such part of the original cable as still existed. And, further, they have provided for the complete extinction of the original loan at the end of 50 years. These facts must be borne in mind in considering the financial prospects of the cable.

82. The Committee cannot conclude this report without expressing their strong sense of the value of the services rendered to them by their secretary, Mr. W. H. Mercer. It has been mainly owing to his exertions that they have been enabled to carry through their work evenly and promptly since their regular sittings first commenced.

SELBORNE, *Chairman.*
DONALD A. SMITH.
A. G. JONES.
SAUL SAMUEL.
D. GILLIES.
GEO. H. MURRAY.

W. H. MERCER, *Secretary.*
Colonial Office, January 5th, 1897.

(To be continued.)

M. BLONDEL'S OSCILLOGRAPHS.*

THE instruments with which Messrs. Duddell and Marchant obtained the results recently described before the Institution of Electrical Engineers attracted so much interest that we think some account of M. Blondel's work on the subject is appropriate. In a paper printed in the *Comptes Rendus de l'Academie des Sciences*,† M. Blondel discussed the principles of construction and the theory of the class of galvanometers

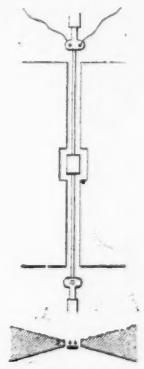


FIG. 1.

named by him oscillographs, with which the forms of the periodic curves of alternating currents may be directly observed. For the design of such instruments he proposed the following five conditions, of which the first two are applicable to all species of indicators, and the last three especially to oscillographs.

1. The natural period of oscillation of the instrument should be very small compared with that of any of the alternations to be observed. For currents alternating with a frequency of 40 to 100, the frequency of a good oscillograph should be at least 50 times as great, say, 2,000 to 5,000 ~ per second; and it would be better to have a frequency 100 times as great.

2. The damping should be regulated as nearly as possible to the critical value of aperiodicity. In other words, the mirror should be damped by the least amount that will prevent it overrunning its correct position.

3. The self-induction of the instrument must be very small,

* Abstract of a paper read by M. A. Blondel before L'Association Française pour L'Avancement des Sciences, Nantes, 1898.

† *Comptes Rendus*, 1893, *st.* cxvi., pp. 502, 748.

in order that its current should be in phase with the impressed E.M.F.

4. Hysteresis and Foucault currents should be guarded against.

5. The degree of sensitiveness necessary for his purpose M. Blondel saw great difficulty in obtaining, as it involved the use of excessively small parts.

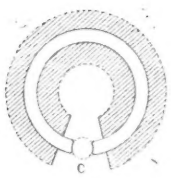


Fig. 2.

To satisfy all these conditions, M. Blondel constructed instruments of two different kinds, which he called respectively the bifilar and the soft iron oscillograph. We will describe these in turn.

The bifilar oscillograph was the instrument that has been brought to great perfection by Mr. Duddell. The one described by M. Blondel in 1893 consists of two fine wires stretched in an intense magnetic field. The current under observation passes up one and down the other wire, so that one wire tends to move forwards and the other backwards. A small mirror attached to them both, turns with their movement about a parallel axis. The whole bifilar arrangement is immersed in a bath of damping liquid. Fig. 1 gives a diagrammatic sketch of M. Blondel's arrangement, for which he claimed peculiar advantages of simplicity of construction, freedom from vibration, and extremely small self-induction.

After proposing this, M. Blondel gave most of his attention to the soft iron oscillograph, until the announcement early last year by Mr. Duddell of his success with the bifilar instrument led him to take up again the study of this type, and to design the instrument described in the paper we are now abstracting. The instrument has but one mirror. The moving part is formed of two strips of aluminium, very thin and very narrow, stretched parallel and close to one another

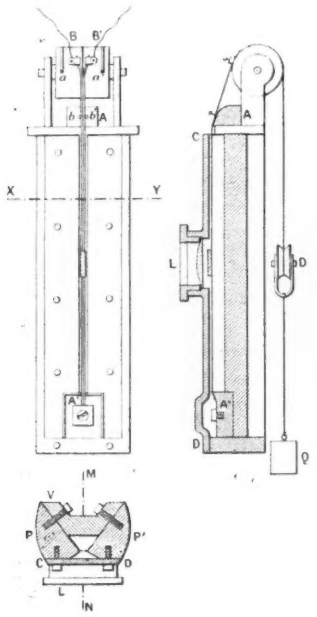
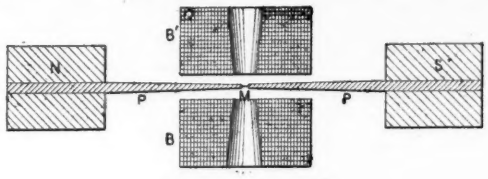


Fig. 3.

between the sharp edged pole pieces of a powerful electro-magnet. The lightness and good conductivity of aluminium afford a better combination of high sensibility with a short natural period of vibration than any other metal.

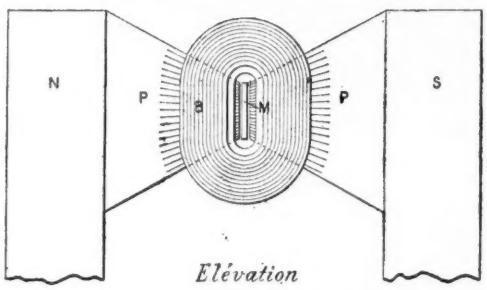
A powerful toroidal magnet, of the form shown in fig. 2, has a cylindrical gap, into which is fitted a part shown in fig. 3. This consists of two pole pieces, P P′, terminated by sharp edges, and connected by gun-metal pieces, V and C D, the whole forming a closed box which contains the damping



Coupe horizontale par le centre du barreau M

Fig. 4.

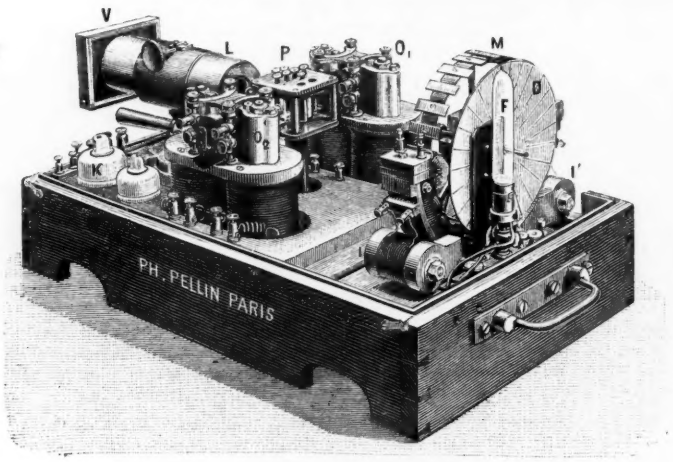
liquid. In the gap between the opposed edges of P P′, 1·5 mm. wide, are stretched the two aluminium strips, ·05 mm. thick, and from ·2 to ·3 mm. wide. A plane mirror attached to them in the centre of the gap is 3 to 5 mm. high. The strips insulated from one another at the top and connected at the bottom are stretched parallel to one another, ·1 to ·2 mm. apart, across two supports, A A′, by means of the pulley, D, and the weight, Q. The current is led into the strips by



Elévation

Fig. 5.

the connections, B, B′. A plano-convex lens is fitted into the cover of the box immediately opposite to the plane mirror mounted on the strips. By adjusting the tension of the bifilar, frequencies of 4,000 to 5,000 can be obtained, and by reducing the length of the strips a frequency of 10,000 has been reached. Placed in series with a resistance the instrument forms a voltmeter. In shunt with a resistance it may be used as an amperemeter. It is remarkable



O_1 O_2, oscillographs; P, total reflection prisms; L, telescope; V, screen, or photographic plate; M, synchronoscope; I, inductor; D, disc with radial slits; F, lamp with vertical filament; K, switch.

Fig. 6.

for its sensibility and its small self-induction, but is more fragile than the soft iron type to be described next.

The Soft Iron Oscillograph.—In this instrument, shown in outline in figs. 4, 5, a very small bar of iron bearing a mirror is hung in the intense magnetic field of a strong magnet. The current to be examined passes through two flat coils, placed one on each side of the poles, which produce an alternating

magnetic field perpendicular to that of the magnet. The bar is long and narrow, and has a very small movement of inertia. The pole pieces are laminated to check Foucault currents. The forces tending to displace the moving bar from its central position are so strong that it is necessary to mount it on pivots. Mounting it on a flat strip of metal reduces the sensitiveness too much. This apparatus is much less fragile and to that extent more convenient than the bifilar. It has, it is true, much more self-induction, but theory shows that this is not objectionable within certain limits if the damping is reduced to a corresponding degree. In M. Blondel's apparatus of 1893 the bar was 4 mm. wide and ·5 mm. thick, and was pivoted between two needles. Its frequency was 1,000, and the damping liquid was Canada balsam. In America, Messrs. Hotchkiss, Millis, and MacKittrick greatly increased the frequency by reducing the dimensions of the bar. With a bar 1 mm. by ·1 mm., having a length of 1 to 2 mm., they have obtained a frequency of 2,000 to 3,000 with a good degree of sensitiveness, and the forces acting on this little piece of iron are so small that it has been possible to carry it on a silk fibre. Unfortunately, the improvement has involved so large a reduction of the mirror surface that the reflected light cannot be observed directly, and is barely sufficient for photography. They were, moreover, obliged to abandon the use of a damping liquid, which is absolutely necessary for accurate results.

In 1896, three years after the work just described, M. Blondel returned to the subject, and retaining all the principal features of his earlier arrangement improved the pivoting and reduced the inertia of his large mirror of 15 mm. diameter. He showed to the French Physical Society in 1897 an instrument which allowed easy direct observation of curves, while the high natural frequency of the mirror, 3,000 to 5,000, ensured great accuracy in the representation of alternating curves of such periods as are in practical use. As to the sensitiveness, ·5 ampere gave a deflection of about 15 mm. at a distance of ·45 m. This apparatus showed, superposed on one another, the periodic curves of the current and of the potential difference of an arc, so that they could be traced or photographed together. The arrangement, shown in perspective in fig. 6, and in skeleton in fig. 7, consists of two oscillographs O_1 O_2, of a

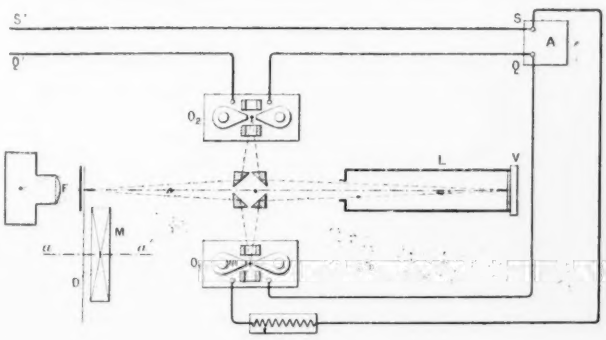


Fig. 7.

group of 4 total, reflection prisms, of a synchronoscope, M, and of an observing telescope, L, with a ground glass screen. Each oscillograph has a powerful electro-magnet, laminated pole pieces, and a moving system of a very small bar of iron pivoted on rubies enclosed in a small ivory box. The box is closed with a plano-convex lens, and the bar carries a plane mirror of silvered microscope glass ·5 mm. thick. The natural frequency of the moving part is more than 4,000. The critical damping point is given by castor oil, but in practice vaseline oil is used, which gives a somewhat smaller but sufficient degree of damping. With this arrangement the mirror follows closely any alternating current in ordinary commercial use, and in the most unfavourable case, that of a curve formed of a succession of rectangles, with a frequency of 40 to 60, no error exceeding 2 per cent. occurred.

The two oscillographs placed opposite to one another are illuminated from one vertical slit by means of the system of four prisms, which also superpose on the screen the two curves described. Between the prisms is placed a small lens which throws on the screen a third image of the slit giving a line of reference the axis of co-ordinates. In adjusting the prisms before taking an observation the three images are brought into coincidence on the screen. We have been speaking of these mirrors as being illuminated from a slit, an obviously unsuitable arrangement if it were not for the action of the synchronoscope. This appliance substitutes for the slit a luminous point travelling with a steady vertical motion. It consists of a small synchronous motor carrying a disc with 24 radial slits which pass in succession behind the vertical slit, and produce the effect of a series of small point sources of light travelling in succession in a vertical line, that of the fixed slit. The time interval between the successive points is the period of alternation of the current under observation. Fig. 8 shows clearly the action of this arrangement.

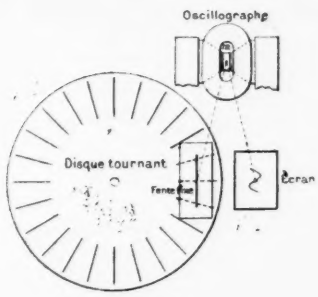


Fig. 8.

The synchronous motor was especially designed for this apparatus. It has neither rings nor brushes, and turns with a velocity of about two revolutions per second. It is synchronised on starting it with the hand, and is supplied by a small transformer, which does not consume more than one-third of an ampere at 110 volts. The observation telescope receives the images either on a photographic plate, or on a ground glass screen; or they may be viewed through a magnifying eyepiece. For the light a projection apparatus may be employed, or a simple incandescent lamp with a vertical filament. A later model has only one electro-magnet, and the path of the light is different, but the effect is the same.

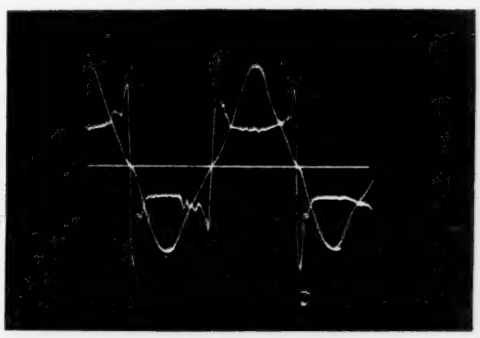


Fig. 9.

The two curves are obtained on a scale quite large enough for practice, and in their proper phases. Fig. 9, reproduced from one of the plates, shows the character of the curves obtained from the current through an alternating arc, and the potential difference between the carbons.

APPROPRIATION OF PROFITS AND REPAYMENT OF LOANS.

Bailie William Maclay, the convener of the Electricity Committee of the Glasgow Corporation, again brings before the Association a short paper on the "Appropriation of Profits and *Repayment of Loans*."

In commenting upon the paper read by this gentleman last

year, we pointed out that, while giving his paper a double title, he had omitted all reference to that most interesting subject to the electrical engineers in charge of electricity supply works, viz., the repayment of loans. We referred, therefore, to his this year's paper with considerable interest, hoping that he had returned to the subject for the purpose of supplying the deficiency of last year, and we are surprised to find that the Bailie again coolly ignores throughout his paper the title which he has prefixed to it. After a careful perusal of the paper, indeed, we are left in doubt as to why it was written; the only difference that we can see between this paper and that laid before the Association last year, being the statement by Bailie Maclay that the principle now adopted in Glasgow is that "every herring should hang by its own *head*," while the principle enunciated by him this year was that "every herring should hang by its own *tail*."

It is certainly a pity that Bailie Maclay, while offering a paper on the Repayment of Loans, should not have dealt with the subject, as the members of the Association, upon the majority of whom rests the responsibility of having to repay the electricity loans out of revenue during a period of 25 years, would certainly like to know on what principle the Glasgow Electricity Committee considers it sufficient to set aside in one year so small a sum as £1,537 in the form of sinking fund to cope with an expenditure of £188,000.

It will be remembered that last year we pointed out to Bailie Maclay that his proposal to carry forward the balance of profits from one year's accounts to the next year's account was "in flagrant defiance of the law." The only comment that the Bailie vouchsafes upon this statement is, that the charge is absurd. We are glad, however, to find that those responsible for the accounts do not share the Bailie's opinion, with the result that the balance of £2,174 10s. 6d., instead of being carried forward, has been placed to the credit of reserve fund. It would be interesting to know whether the Glasgow Electricity Committee, in their desire to conform strictly to the law, have invested their reserve fund, as directed by their provisional order, "in Government securities or in any other securities in which trustees are by law, for the time being, authorised to invest."

On the question of the appropriation of profits, those responsible for municipal finance are divided into two camps. On the one hand, there are those who consider that the consumer should have first consideration, and should be supplied as nearly as possible at cost price; whereas, on the other, there are those who hold that where public money is involved the consumer should pay a somewhat enhanced price as a sort of insurance fund for the benefit of the general body of ratepayers.

The Glasgow Electricity Committee pose as taking the former view, but in practice they take the latter, for in no place in the United Kingdom is the consumer burdened with so heavy a contribution to the General Rate Fund as in Glasgow. In making this statement we would point out that there are two ways of securing the interest of the general ratepayer as opposed to the consumer. The one by contributing out of the revenue of the electricity works large sums for the relief of the general rate fund, the other by contributing out of that revenue large sums for depreciation. In either case the price to the consumer is enhanced for the benefit of the general ratepayer.

Bailie Maclay and his Glasgow friends pose throughout as upholders of the view that the consumer should be first considered, but in practice they take care that the consumer's interest should be secondary to the interests of the general ratepayers. In no place in the United Kingdom outside London, where coal is so expensive, where the output is about on a par with that of Glasgow, is the consumer so badly off as he is in that city. On an examination of the accounts the reason for this is clear, for Glasgow burdens the consumer with a larger sum for depreciation than any other undertaking in the kingdom. In last year's accounts the item of depreciation amounted to £8,945, equal to 5·42 per cent. upon the average capital invested in the undertaking during the past year.

This may be extremely sound finance, and those who are responsible for it may be worthy of all praise, but they should not come into the field as advocates of the policy of giving the consumer all the benefit. After sweating him to a greater extent than he is sweated in any part of the kingdom, the consumer may fairly respond to their expressions of concern for his benefit by the well-known lines, "Perhaps it was right to dissemble your love, but why did you kick me downstairs?"

CORRESPONDENCE.

Wholesale v. Retail.

I crave a small space in your valuable medium on behalf of the more commercial class of your readers; I refer to those engaged in retail trade.

As you are aware, during the past three or four years electrical businesses have been opened in practically every town in the kingdom. To the efforts of the people carrying on such businesses must be attributed a large portion of increased confidence in and use of electricity, and consequently the manufacture and supply of materials for the application thereto. Now, contractors and retailers are supplied by a number of professedly wholesale traders, whose methods appear anything but honourable, since they will take the advantage of the retailers' recommendation and sell even a pair of dynamo brushes, or a Leclanché cell, with full trade discount. May I give you a sample, one of a great number? Some little time since a customer of mine asked quotation for a dynamo. I brought under his notice a suitable machine and recommended it to the utmost; judge my surprise to find a month later that the dynamo had been supplied by the makers at full trade discount. On complaining, I am informed, "Well, the man came to us and we thought if we did not give him trade terms, some other manufacturers would."

This, you will admit, has no satisfaction for the man whose efforts really sold the machine, and is, so far as this district is concerned, becoming very general. It is doubtless the same throughout the country, and your suggestions, together with those of your readers, in view of removing the evil, will be appreciated by

A Disgusted Retailer.

Correction.

While thanking you for the article in last week's issue of your valued journal regarding the acquisition of the Singer Company by the Helios Company, of Cologne, whose interests we represent in this country, we should feel obliged if you will kindly correct the statement that the Helios Company are only now embarking on the construction and installation of electric traction lines. Permit us to state that the Helios Company have been engaged in this class of work for some years past and have already several important lines on the Continent running, and others being completed. The present acquisition is, therefore, only an extension of their traction department, while the article might produce the impression that traction work was only now to be started at their workshops.

Witting Bros.
For the Helios Company.

Electric Piping.

I quite agree with "J" in the side of the question which he takes in regard to twin lead-covered wires, as tradesmen on the job at the time of wiring are not over particular where they drive nails, &c.

I think iron piping with an inside lining is the best for buildings in course of construction, and plain iron piping comes next; and without doubt the Simplex steel tubing makes the best third.

If the Simplex steel tubing could be drawn instead of rolled as at present, which would do away with the seam, I think the steel tubing would be the best method for concealing wires in the market, as you have lightness, cheapness, and ease of working combined.

In reference to the last part of his letter, I must say he is labouring under a delusion when he says that only skilled workmen are employed in Edinburgh laying wires for electric lighting. I have had charge of work in several

large towns in England and Scotland, and have never come across so many raw hands at electric wiring as I have in Edinburgh, and I must say very few who have passed the City and Guilds of London examination.

The majority of wiremen in Edinburgh are either joiners or labourers who have been beside a wireman for a short time.

G.

THE INSTALLATION OF STEAM BOILERS.

I.

THOUGH there are certain well-recognised standards for the construction, equipment, and erection of steam boilers, it is surprising to find in how many instances these standards are departed from. Were such departure in any sense an improvement no particular fault need be found, though any serious departure from recognised standard practice should be supported by good reasons. Unfortunately, however, almost all the departures which are to be found in new installations are degenerations. They are lapses into a past practice which was due to ignorance, and has been discarded as the result of the teachings of experience. What is known as the best practice is, of course, that which has been developed by the experience of the leading boiler insurance companies, and has been chiefly carried out by the leading boiler makers, and also added to and improved by them in friendly conjunction with the companies.

It is our purpose in this series to deal with some of the details of boilers and their surroundings in a more or less critical manner, with a view to showing from illustrations of past practice some of the causes which have led up to present practice. The maintenance of high standards of construction, even where no additional expense is involved, is a difficult matter. There is apparently an inevitable tendency in human nature to fall short of highest and already attained standards, and some of the most modern steam plants are years behind best practice in certain details. For purposes of fixity of ideas we have confined our remarks chiefly to the Lancashire type of boiler. They are sufficiently applicable to the Cornish type without alteration and fairly so to the marine type. The water-tube boiler is so much *sui generis*, and so much designed by its manufacturers that the influence of the boiler insurance companies is not so apparent, and the type is structurally so very different as not exactly to come within the scope of our remarks. The present status of the Lancashire boiler and its highest type of equipment and finish are due to a process of more or less painful evolution. Brittleness of plates and poor workmanship ought not to have required an explosion to render their danger visible. Yet many explosions have been necessary to demonstrate that mere tenacity of material is in reason a less important factor than ductility. Taking up the boiler at the time of the first founding of the principle of regular inspection, it may be well to give a brief *résumé* of what a steam boiler then was, how it was made, set, and worked. We will not say that every fault we enumerate was present to its full and worst extent in any one boiler, but it may be assumed to have been in order that each fault may be traced up towards elimination. Sufficient to say that all the faults named were exceedingly common and distinguished the general practice of the time. An ordinary boiler would be 7 feet diameter and 28 or 30 feet in length. As such a boiler made of $\frac{3}{8}$ iron plate would be nominally safe at 50 lbs., and 30 lbs. would be a usual pressure, there was no great care in construction. All seams would be single riveted with holes conically and irregularly punched and drifted out true at a pitch of 2 inches. The plate edges were left as sheared, and there was no break of joint in the longitudinal seams of rivets. The end plates were in two or more pieces and were attached to the shell by small inside angle irons. The furnace tubes were riveted both longitudinally and circumferentially and were not truly circular. The end plates were stayed to the shell by gussets much as they now are in number and position, but the angle iron attachments to the end plates were placed as close as possible to the ring of furnace rivets and were single only, and the rivets of the stay plates were merely knocked over, not in any way closed. The manhole mouthpiece was of cast-iron with no stiffener plate, and it was often bolted to the shell or even absent, the shell being simply cut and fitted with a curved cover held by a bolt and bridge bars. There was no mudhole mouthpiece, and as the flue tubes were of the same diameter from end to end the bottom of the shell was not accessible. The feed pipe entered the boiler near the bottom of the front end-plate or through a branch on the blow-out pipe which was a simple cast-iron flanged pipe bolted to the bottom of the first shell plate. The boiler bottom was thus kept cold.

The bottom flue was made so shallow as to preclude inspection, and the walls of the side flues touched the boiler at its horizontal diameter, while the side flue bottom was kept high and the flue was often too small to get through. The boiler was rested on two longitudinal walls which had a breadth of contact on the shell of 12 to 20 inches and sometimes a mid-feather bearing wall was also present. It would be 14 inches wide or more. The front cross wall was built from 14 to 24 inches thick, and was securely built round the elbow pipe, so that if the seating walls gave way at all the weight of the boiler was then carried on this blow-out pipe which, by its fracture, gave notice of something wrong.

The floor level was 6 inches above the level of the boiler bottom, and the plates covering the hearth pit abutted upon the front end plate of the boiler. There were no openings from the front into the flues except through the furnace and thence usually by the side flues to the bottom flue. Above the top of the side flues the brickwork was 14 to 18 inches thick against the boiler shell. There was a dome 3 feet diameter riveted to the shell crown which was cut out with a hole about the same diameter, irrespective of weakening the shell plate.

The cover plates of the hearth pit were large and massive and rarely lifted. The water gauge cocks, on the contrary, were small and paltry. The blow-out tap was of cast-iron, and the safety and junction valves were bolted to the shell crown. When sold by weight the boiler shell was strengthened (?) by horizontal and vertical diametrical bar stays about $2\frac{1}{2}$ inches square with eye ends and pins securing them to angle iron cheeks riveted on the shell, and sometimes there were several longitudinal bar stays, and it was difficult to get about inside the boiler. Such were the boilers which could be found in large numbers even up to the last 15 years, and many of which are doubtless still in working existence in old works. To round off the description, it may be added that boilers were placed in any dark corner that could be found for them, and too much care was not exercised even to secure a dry foundation.

Externally the safety valve, and there was often but one, was of the closed type, the spindle passing through a gland or, at least, through a bored hole which fitted the spindle and often bound it tight, and the escaping steam was led off by a waste pipe to some distant invisible point where, exposed to frost in winter, its end could freeze solid and cause over-pressure, ending in explosion. The single safety valve would often form a part of the junction valve casting, and sometimes it would be on a branch pipe and serve two boilers. Generally, it may be said that disaster was invited by a structure whose quality was such as to qualify it as an open cold water tank. In what follows we shall endeavour to point out some of the salient features of modern practice in the construction, installation, and working of steam boilers, confining ourselves, for the present, at least, to one type, the Lancashire.

(*To be continued.*)

MACHINE SHOP MANAGEMENT IN EUROPE AND AMERICA.

THE chief point laboured by Mr. Orcutt in his sixth article in the *Engineering Magazine* is the fact that besides special tools the American manufacturer possesses materials on which to work that are easier to cut, are nearer to size, and demand less surplus to be removed, and are generally more amenable to treatment than materials to be used in Europe. This is so. Material has been studied in America with a view to being rapidly manufactured into some saleable product. Europe might with advantage pay more attention to these points. But we know that too much has been done by Americans to ease the operations of tools. If their machines are well designed, they are flimsy, but they

have flimsy materials to work upon. Take the American bicycle. It is cheap and it is made in large numbers. But it is made of easily worked materials, and it has soft bearings. Expert bicyclists say that no one who understands a bicycle will buy two American machines. Here is an example of materials placed before durability, and this is the chief fault of American productions. Durability is sacrificed to ease of manufacture; at the same time we do think that more care might be given to materials and especially to careful sizing so as to reduce the labour of removing stock. Mr. Orcutt considers that Americans have an unduly exalted idea of their own superiority, and would have them know that some of the English works are ahead of anything in America, while the English loom and the marine engineering of England has no equal in America. Nor is there the same skilled labour in America as in Europe, where the spirit of the old craftsman still survives. At the same time the American aims to produce by machinery something which is good and cheap, and the question is under which system is the greater progress possible. In certain classes of machine tools, however, the author considers the English are ahead of American practice as in heavy milling machines and slotters. Generally, the indictment is that in Europe there is too much handwork still performed where automatic machine work is possible.

Europe has been neglectful of grinding machinery, of tool rooms, and of turret lathes, though he admits that a Coventry firm can show a turret lathe fully comparable with the American. He also praises the brass work of America, as to which, however, we may state that our own experience is that English goods are as accurate, can be bought cheaper, and are not so starved of material as American products, while, as regards pumps, we are much inclined to doubt whether the direct acting steam pump has been worth having. It is wastefully extravagant of steam and is not an over desirable article at best. Chiefly, however, Mr. Orcutt laments that Europe is wanting in good skilful tool makers. Europe has the men of ability, but they are rather making the article itself than making machines to do this for them. Lack of accessories, as stated above, is stated to be responsible for the fact that American tools have a less output in Europe than in America, though part of this is due to harder materials on which to operate, a not altogether unmixed evil. American machine tools are good enough for American materials, but they are stated to be too light for European materials for which American models require much strengthening. So far too only the best American makers have been sending to this side. Now the lower grades of makers have begun to export, and much rubbish is coming over with weak parts and bad finish. American workers, however, are usually better equipped with fine tools, as callipers and measuring appliances, up to $50 or $100 in value.

The author refers to an American who has been sending over engines and paying 30 per cent. duty. This cannot be England. American pumps, we all know, come freely over, and have indeed demoralised the pump industry, and, we fear, done much to exhaust our coal-fields. The American cycle is hardly likely to sell so freely again, unless improved in material and inside finish and hardness. In electrical machinery America will for some time continue to send over her productions. In steam engines and electrical work America does well, and would do better but for a certain lack of good finish observable, and too much attempt at show in the shape of shoddy nickel plating without even a copper basis. It is curious how this nickel plate craze still holds America in its grip. There is nothing too bad to say of a universal use of nickel plating. It is vulgar, garish, and tawdry. In regard to manufacturing, American methods are good. They were the methods of England before trades unionism stopped the wheels of progress, and they will again come to the front, and the author considers that in things social and political, America will fall into trouble.

Here he is a bit inconsistent. Up to now the American workman has been a soulful, intelligent product, but it appears that he is forging the instruments of his own destruction, and becoming a mere slave, with no diversity of labour and no mental development or progress. The fact is, that in America speed has been aimed at and secured, and the proper accompaniment of short hours has been refused. In Europe, or at least in England, we have got down to the short hours, but the trades unions have forbidden the necessary and proper speeds for such hours. We scarce know which country is in worse plight. It seems folly to work such long hours and forego the real end and aim of machinery, which is to produce large quantities of goods and set free the manual toiler. In America the toiler is no better off for all the labour-saving machinery, and here the toiler has got down to short hours and could easily have another hour knocked off if he would only let machinery do what it would do.

Mr. Orcutt does not draw a very hopeful picture of American labour as regards social and economic standing. But he does show plainly how very much regard is paid to increased output, even at the price of sacrificing durability. Both sides may take a lesson on this point. Is it necessary to sacrifice durability in order to produce in quantity? It would almost seem so, if we are to judge by American productions, by the very soft metal one finds in steam cylinders and on machine tools, and in many other places where hardness would be an advantage. But, again, European materials might be made nearer to size and save work in reducing. Doubtless practice will converge on these points and effect a compromise. Americans are as good copyists as are Europeans, and though we hear much of the good appearance of their tools, and in light and small tools they do lead, their productions other than tools have been very unshapely. In locomotives, for example, until they dropped the crude mouldings and copied English models more closely, the American locomotive had no design, except as a thing to draw a train. It is better now, and soon we shall be seeing some running, when there will be an opportunity to gauge the quality of *materials* of construction.

LEGAL.

BLACKWELL *v.* GREENWOOD & BATLEY, LIMITED.

THIS case came before Mr. Justice Bruce, sitting without a jury in the Queen's Bench Division on Friday last—an action brought by the plaintiff, of 39, Victoria Street, Westminster, to recover from the defendants, of the Albion Works, Leeds, £608 15s. 2d. balance of account for the price of goods sold and delivered. The defendants, while admitting the plaintiff's claim, alleged that they were entitled, by way of set-off or counterclaim, to deduct £525 19s. 1d, and brought into Court the sum of £82 16s. 1d., which sum they said was sufficient to meet the plaintiff's claim. From the counterclaim set up by the defendants, it appeared that in June, 1896, the Corporation of Leeds invited tenders for the supply of 25 electrical motor cars to be used in a system of electrical overhead haulage to be constructed in accordance with the terms of a specification and general conditions of contract which had been prepared on behalf of the Corporation. Part of the system of electrical overhead haulage included the supply for each motor car of a trolley which was to be of the swivelling-arm type of the latest design, as manufactured by the makers of the trolleys supplied to the Bristol Tramways Company. Each trolley standard was to have a base fixed to the roof of the motor car, and the conditions prescribed by the Corporation required that there should be a suitable arrangement on the roof of each car of adequate strength for attachment to the trolley base. On June 6th, 1896, the defendants informed the plaintiff who supplied trolleys to the Bristol Tramways Company, and that they (defendants) were tendering for the supply of the motor cars, including the trolleys to be attached thereto, and between that date and June 21st, 1896, the plaintiff went through the specification and general conditions of contract, and became fully acquainted with the nature and design of the trolley which was required, and the conditions subject to which it was to be supplied. The plaintiff was then requested by the defendants to send to them quotations of the prices at which he could supply and fix the trolleys, and to supply particulars and plans of the trolley which was to be made. The plaintiff did this, and on June 22nd the defendants sent in to the Corporation a tender undertaking to build and supply 25 motor cars, complete, in accordance with the specification and conditions, and guaranteed to uphold the same in perfect order and condition for the space of 12 months for the sum of £14,000, and the defendants' tender was accompanied by the plaintiff's plan which he had made. This tender was accepted, and on July 27th a formal contract was signed by the defendants. On November 17th, 1896, an order for the complete trolleys to be supplied for the motor cars as quoted by the plaintiff to meet the specification and general conditions and plans was sent to and accepted by the plaintiff. The plaintiff supplied to the defendants the trolleys which were fixed to the motor cars, each trolley comprising a trolley standard, which was made to stand on a base fixed to the top of the roof of each motor car. In August, 1897, the trolley standard on one of the motor cars broke and injured three passengers named Mrs. Fell and a Mr. and Mrs. Heaton. The defendants alleged that the trolley was defective, inasmuch as the standard met the base at right angles, whereas it should have been curved where it met the base. Actions for damages were then commenced by the passengers against the Corporation, and the Corporation claimed damages from the defendants in respect of the defective trolley which caused the accident. The defendants gave the plaintiff notice of this claim of the Corporation, and told him they should hold him responsible for any damages they might sustain as the result of the accident. The plaintiff denied all liability for the fracture of the standard, and the defendants paid the damages and costs which the Corporation had to pay to the passengers, viz., £483 16s., and a further sum of £42 3s. 1d. incurred by themselves in respect of the actions, making together the sum of £525 19s. 1d., which they claimed to set off against the plaintiff's claim.

[The decision will appear in a later issue.—EDS. ELEC. REV.]

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—A first meeting of creditors under a receiving order made against W. J. C. Wain, civil engineer, director and financier, was to be held last week, but as there was not a quorum the meeting adjourned until 21st inst.

A receiving order has been granted in the case of G. T. Godfrey (Godfrey Bros.), builder and electrical engineer, of Balham and Tooting.

A receiving order has been made against A. G. Inrig (Globe Electrical Company, White Post Lane, Victoria Park, London), upon the petition of a creditor. The first meeting of creditors will be held at Bankruptcy Buildings on June 21st, and the public examination on July 20th.

Books Received.—"Leçons sur L'Electricité," by Eric Gérard. Sixth edition. Paris: Gauthier-Villars & Son, 1899. 12 francs.

"Duncan's Manual of Tramways, Omnibuses, and Electric Railways." 1899. Twenty-second edition. London: T. J. Whiting and Sons. 3s. 6d.

"Text-book of Applied Mechanics," by Prof. A. Jamieson. Third edition; Vols. I. and II. Published by Charles Griffin & Co., Limited, London. 7s. 6d.

"Les Arbres à Gutta-percha et leur Culture," par Henri Lecomte. Paris: Carré et C. Naud.

Electrical Wares Exported.

Week ending June 14th, 1898.		Week ending June 13th, 1899.	
Adelaide	Value £187	Adelaide	Value £72
Amsterdam	130	Alexandria. Teleph. stores ..	116
Auckland	293	Amsterdam	110
Bahia	614	Bahia	172
Bombay	52	Bombay	118
Boulogne	122	Boulogne	28
Buenos Ayres	189	Buenos Ayres	1,325
Calcutta	119	„ Teleg. mat. ..	242
Cape Town	2,784	Calcutta	170
Copenhagen	11	Cape Town	1,723
Durban	26	Christiania	87
East London	123	Colombo	200
Fremantle	2,794	Copenhagen. Teleg. cable ..	816
Hong Kong	85	Durban	1,814
Monte Video	81	East London	10
Nagasaki	690	Fremantle	15
Nelson	12	Gothenburg	33
Ostend	85	Hamburg	300
Penang. Teleg. mat. ..	400	Madras	18
Port Chalmers	442	Malta	89
„ Elizabeth	350	Ostend	50
Rio Janeiro	1,154	Otago	22
Rotterdam	248	Port Chalmers	75
Saigon	16	Port Elizabeth	908
Santos	397	Rotterdam. Teleg. mat. ..	233
Singapore	54	Shanghai	170
Stockholm	161	St. Petersburg. Teleg. mat. ..	156
Sydney	725	Sydney	810
Tantave	33	Teneriffe	32
Valparaiso	48	Trieste	11
Wellington	40		
Total ..	£12,455	Total ..	£9,925

Foreign Goods Transhipped.

Colombo.	Elec. supplies.	Value £90
Fremantle.	Elec. goods ..	31
	Total	£121

Electrical Works at Wolverhampton.—We have before us an illustrated brochure, "Wolverhampton and South Staffordshire," in which the principal places and buildings of interest in the neighbourhood are briefly mentioned, some excellent photographic views accompanying the text. Among the important industries of Wolverhampton, the electrical trades hold a leading position, dating from the commencement of the Elwell-Parker works in the year 1882. At the present time there are the Electric Construction Company, Messrs. T. Parker, Limited, the Electric Street Car Manufacturing Company, and Messrs. G. R. Blot, Limited. The chief feature of electrical interest in the compilation is a well illustrated account of the works of the Electric Construction Company at Bushbury. The foundry, the armature core and winding shops, erecting and other departments, are all shown, and some of the principal manufactures of the company are particularised. In one of the pictures there is shown an armature core of a 1,200-H.P. E.C.C. dynamo weighing 27 tons.

The Electrophone.—The Electrophone Company rendered able assistance to the Hospital Fund movement on Sunday last by connecting a number of the London Hospitals with various places of worship. Special wires had to be provided in some cases.

Fire at Elswick.—Early on Sunday morning a fire broke out at Messrs. Armstrong, Whitworth & Co.'s Ordnance Works at Elswick. A considerable quantity of machinery, engines, guns, &c., also the three large shops in which they were housed at the time, were completely destroyed, the damage amounting to £150,000. According to Sir Andrew Noble over 1,500 men will be temporarily thrown out of employment; he referred in a statement made the other day to the great difficulty they would have to meet in replacing costly and elaborate manufacturing machinery which had been destroyed.

Gold Medal.—The Improved Electric Glow Lamp Company, Limited, have obtained a Gold Medal for their lamps at the International Exhibition, recently terminated at Rome.

Liquidations.—Messrs. Galloways, Limited, decided in meeting at Knott Mill Ironworks, Manchester, on May 23rd, to reconstruct, and for that purpose, to wind up voluntarily, Mr. J. W. Pollitt being appointed liquidator. Mr. Pollitt is authorised to register a new company under the same title and to enter into certain agreements.

Lists.—Messrs. Dobson & Curtis Bros., Limited, send us an illustrated price list of various types of switches, cut-outs, lampholders, fuse and switchboards, and other accessories for high voltage supply.

The General Electric Company, Limited, has brought out a new price list of ceiling, desk and table fans, blowers, &c., for continuous and alternating currents.

The Nernst Lamp.—On the 7th inst., the chairman and directors of the Nernst Electric Light Company, Limited, took advantage of the fact of Prof. Nernst's presence in England to attend the centenary of the Royal Institution, to invite him and Madame Nernst to a dinner given at the Hotel Cecil. In proposing the health of the guest of the evening, Sir Henry Mance congratulated the Professor on having contributed to the electrical industry an invention which would be welcomed throughout the world by all those who used the electric light. Probably no man of science had been so much talked of during the last three months as Prof. Nernst. The Professor, in replying, stated that, after seeing the lamps made by the other concessionaires, he had experienced great pleasure in noting the advances which had been made in England since the formation of the Nernst Electric Light Company. They had evidently done much to perfect the details so as to adapt the lamp to all commercial requirements. He considered that the child which had been born at Goettingen had quickly grown to a strong youth in this country, in fact, he might say that it had outstripped its elder relations abroad. He congratulated the executive staff of the company on the very practical lamp which had been submitted to him, especially as regards the automatic shadowless heater with which it was possible to render the lamp incandescent in about 6 seconds. The Professor left for Germany on the following day.

Offers Wanted.—The Cardiff Corporation want tenders for the purchase of a 40 kw. Paxman-Siemens steam alternator. For particulars see our "Official Notices" this week.

Personal.—Mr. Herbert A. Wood, A.M.I.E.E., late electrical engineer at Blackpool Tower, has joined the staff of Mr. Charles Hopkinson, M.Inst.C.E., 29, Princess Street, Manchester.

Private Electric Bills.—It has been notified that a Committee of the House of Lords, under the chairmanship of the Duke of Bedford, will, on Thursday, June 22nd, consider a group of opposed Bills, comprising, amongst others, a measure to confirm a provisional order of the Board of Trade under the Electric Lighting Acts in relation to Bermondsey; the Central Electric Supply Bill, the Central London Railway Bill, the Charing Cross, Euston and Hampstead Railway Bill, and the Kensington and Notting Hill Electric Lighting Bill.

Skewse-Cox v. Pritchetts & Gold.—This case, heard by Judge Lumley Smith, Q.C., in the Westminster County Court on Monday, was an action brought to recover damages from the defendants, electricians, for breach of covenant. The case for the plaintiff was that he was suing as executor under the will of the late Mr. Warne. Defendants occupied 31, Soho Square, W., under an agreement with Mr. Warne. The agreement stated that the premises were to be left in as good a state of repair as when the tenancy began. When defendants left the premises it was found they had not complied with the agreement. Electric wires were hanging in festoons, some had been carelessly torn down, and others not removed at all. The wires left were of no use to an ordinary consumer, as they were cables for a large number of lights. A great number of dilapidations were detailed. The defence was that the premises were left in as good a state as possible after a tenancy of 6½ years. The casings and wires left up were in use by the present tenants. It was not correct to say they would be of no use to an ordinary consumer. If they had had gas the place would have been very dirty—electricity made no dirt. The "dilapidations" were caused by ordinary wear and tear. Defendants paid £20 into Court to cover everything. His Honour held that that sum covered the damage, and gave plaintiff judgment for that amount, with costs.

Trade Announcements.—An amalgamation has taken place of the firms of Tozer Bros. & Co., of 85, Gracechurch Street, Walter Kemsley & Co., of 44, Leadenhall Street, and of Buddon, Fisher & Co., of 47, Lime Street, E.C., and they will in future carry on business at Leadenhall Buildings, 96, Gracechurch Street, E.C., as Tozer, Kemsley & Fisher, Limited. No issue is to be made to the public.

Messrs. Foxcroft & Duncan have transferred their agency for the North of England from Messrs. James & Mills, Salford, to Messrs. Thos. Bell & Co., Limited, Cromwell Buildings, Blackfriars Street, Manchester, who will act as agent for the whole of their manufactures for that district in future.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The Tramways Sub-Committee have agreed to erect 32 side electric lights in George Street in place of the 19 overhead lights, and to continue them as far as Fraser Street instead of Hutcheon Street as at present.

The Corporation will undertake to maintain the arc lighting installation now erecting for the Harbour Commissioners at £400 per annum.

Barking.—The formal opening of the electric supply works took place on Thursday, June 8th, the ceremony being performed by Mr. W. K. Marriott, late chairman of the Council and the Electric Lighting Committee, who was presented with a handsome gold key for the purpose. Invited guests were shown the machinery, and afterwards refreshed in the Council chamber and entertained to a late hour with oratory and music. About nine o'clock Mr. Marriott proceeded to the balcony, and in view of the assembled populace switched on the current, a proceeding that appeared to give great pleasure to the man in the street, who for the rest of the night paced the well-lit thoroughfares assiduously. It is not every day that such an exciting event occurs at Barking.

Barnet.—The Board of Trade has asked the Council for particulars as to the amount of subscribed capital held by the electricity company, and the North Metropolitan Electric Power Distribution Company had written to say that 3,000 shares of £10 each had been subscribed and allotted, one half of which it was intended to apply to the carrying out of the Barnet order.

Barnsley.—The Council has requested the electrical engineers to prepare estimates for lighting with electricity several buildings, including the public hall, free public library reading room, corn exchange, weigh-house, chapel, and registrar's house at the cemetery, and town hall.

Barrow.—The Council is hurrying up the electrical contractors with the plant on order, as inconvenience is being caused to consumers, who are waiting for connection to the mains.

Barton.—The Local Government Board has sanctioned the borrowing of £3,355 for the electric light installation at the new infirmary.

Bath.—The Electric Lighting Committee has decided that the consulting engineer is to see that the troublesome arc lamps are put in order within a month. If they are not right by then new ones are to be obtained. The city treasurer attended last week's meeting of the Electric Lighting Committee with respect to the Committee's obtaining more money on the capital account. As they stood, he said, they had a borrowing power of £4,452, and they had overdrawn at the bank on the capital account by £132. The bank stated they were prepared to make the advance of £3,000 for six months, on security under the seal of the Corporation for that sum. They would get the loan at the usual bank rate of interest. The last time he was at that Committee he was in error in telling them they were advancing money on the current account, when it was on the capital account. The matter was referred to the Finance Committee. The chairman mentioned they intended asking the Local Government Board to give them power to borrow £24 000, and a meeting of the Council would be held on the 20th or 27th to obtain sanction to apply for the loan.

Bexhill.—Last Monday a representative of the British Electric Traction Company was to meet the Urban Council to discuss the proposed transfer of the provisional order. The Council's consulting engineer, Mr. Preece, was to be in attendance.

Blackpool.—At last week's Council meeting Alderman Brodie, in moving the adoption of the Electric Lighting and Tramway Committee's minutes, called attention to the resolution that the maximum charge for electricity be reduced from 8d. to 7d. per unit from July 1st next. He said the Committee had come to the conclusion that the works warranted the Committee in making a reduction. They were unanimously of opinion that the Brighton system of charging was the proper one. It was expected that there would soon be a further reduction, and they would eventually not only have the Brighton system of charging, but the Brighton charges of 7d. and 1d. As to the progress of the overhead trolley tramway, Alderman Brodie said that perhaps they might have some of the trolleys running on the following day.

Bray.—Messrs. Allingham & Fennell have offered to submit to the Council a proposal for constructing a promenade pier and electric tramway service for Bray and the district. Consideration is postponed pending the receipt of further details.

Brazil.—The *South American Journal* says that Messrs. William Reid & Co., in December of last year, obtained a concession for the establishment of one or more central stations within the municipal boundaries of the capital, with exclusive right to furnish electric power for industrial purposes during a period of 40 years (previously acquired rights being respected), as also for the distribution of same by cables laid in trenches, or on posts in the public streets. The concessionaire, in return, undertook to pay 5 per cent. of the yearly gross income to the municipality of Rio de Janeiro. This concession was vetoed by the Prefect, Dr. Luiz van Erven, against which appeal is now being made to the Senate. In a statement on this matter, addressed by Messrs. Reid to the President of the Republic, it is pointed out that, among other advantages of their proposals, is the possession by the firm of inexhaustible natural power for the generation of electricity in the Rio das Lages, at a distance of only 70 kilometres from the city, with an almost perpendicular fall of 300 feet. Electricity thus generated at a minimum cost could be utilised for driving tramcars, city lighting, or even as motive power on the Central Railway. The concession has been condemned by some as a monopoly, but Messrs Reid consider that there can be no such monopoly where everyone is at liberty to produce power for his own use, the only privilege being in its distribution. The petitioners also offer, free of all cost, the whole of the water available, after passing through the turbines, to supplement the insufficient city supply. This they estimate at 700,000,000 litres per 24 hours.

Bristol.—Mr. Rogers, a member of the electricity works staff, recently left to take up a post at Newington, and Mr. A. R. Bell, of Morley, Yorkshire, has taken his place as third engineer.

Canterbury.—Last week the city electrical engineer, Mr. Staniland, reported to the Council that 3,415 8-C.P. lamps were then connected. The Council resolved that the Dean and Chapter of Canterbury Cathedral be approached for permission to lay the cables around the precincts.

Cardiff.—The proposal of the Lighting Committee to promote a fitter to the post of electrician at the electricity works has been referred back by the Council for further consideration.

Carnarvon.—Four or five shopkeepers in the principal street are going to put down a plant for lighting their premises electrically. The Council threatened proceedings if the streets were interfered with, so the plant will be erected at the rear.

Colchester.—The Colchester Town Council have resolved to apply to the Local Government Board for sanction to borrow a further sum of £6,500 for electric lighting purposes; it being found that the installation has cost £16,614, instead of £14,900, the amount sanctioned. The electricity works started on December 1st, and by March 25th there were 60 consumers with 3,333 8-C.P. lamps. 15,325 units were sold, and the total revenue was £429 14s. 10d., against £260 for working expenses. The Electric Light Works Committee has recently conferred with Mr. W. H. Massey as to the working of electric tramways from the present lighting plant.

Cowes (I.O.W.).—The District Council has decided the positions of the arcs and incandescents for street lighting.

Cromer.—Mr. E. H. Cozens-Hardy attended the Urban District Council meeting on Monday, and it was decided to proceed with the electric lighting scheme subject to land purchase being arranged.

Darlington.—A Local Government Board inquiry has been held *re* the proposed £30,000 loan for electric lighting, the estimates amounting to £25,784. The scheme adopted, as drawn up by Prof. Kennedy, is for 10 arcs and 4,500 8-C.P. incandescents on the three-wire low tension system.

Derry.—As mentioned last week, Derry, which has for some years had its streets lighted by electricity, has been considering the question of a private supply. The Lighting Committee has met and considered the report of the corporation electrical engineer (Mr. MacRory). It was suggested that application be made to the Local Government Board for a £20,000 loan. It was further suggested that the resident engineer prepare the necessary plans and specifications, and that Mr. John Christie, of the Glasgow electrical department, be appointed consulting engineer. After discussion, however, it was decided by 4 votes to 3 that the information before the Committee as to the cost of private lighting in other cities of similar size was insufficient. Further inquiry on this point is to be made. The scheme suggested by Mr. MacRory, after visiting various English works, was a three-wire low pressure continuous current, the plant capacity being 4,500 16-C.P. lamps.

Dorking.—The Urban Council has shelved the electric lighting question for the present, and has entered into a five years' contract with the Gas Company on certain conditions.

Eastbourne.—Some members of the Electric Light Committee inspected the Tunbridge Wells electricity works last week.

Edinburgh.—Although not on the Council's agenda, the Council last week passed, as a matter of urgency, the Electric Light Committee's recommendation that estimates amounting to £5,000 be accepted for engines, &c., at the M'Donald Road power station.

Electric Lighting Orders.—In the House of Lords last Friday the Earl of Morley called the attention of the House to the common form clauses of Electric Lighting Provisional Order Bills. He said there were 19 Bills dealing with 90 orders. Each order consisted of 36 pages, of which 30 contained common form clauses; and, from the great bulk which these Bills assumed, it would be seen how necessary it was that the Electric Lighting Orders (Common Form Clauses) Bill should be pressed forward in the other House. The examination of these Bills after they had received the Royal Assent involved great labour, not to speak of the enormous amount of printing. If the Bill could not be passed this Session, he suggested that the Board of Trade should group a large number of orders in single Bills, and schedule the common form clauses at the end of each Bill. Lord Balfour, in the absence of the Earl of Dudley, said the Board of Trade were deeply impressed with the strength of the case put forward by the Chairman of Committees. It was their intention to pass the Bill this Session if possible. Failing that, the alternative suggestion of the noble earl was well worthy of the consideration which he had no doubt it would receive.

Exmouth.—A committee has been appointed to inquire into the matter of electric lighting with reference to a letter received from Messrs. Taylor & Field.

France.—The Midi Railway Company, of France, is about to put down a large plant for the electric lighting of the railway station, workshops, &c., at Bordeaux, and also for the operation of the machine tools at the works. The generating plant will comprise four steam dynamos of a capacity of 285 kilowatts. The plant is estimated to cost £36,880, and is expected to be completed early next year.

Glasgow.—The Street Electric Lighting Sub-Committee has remitted to Mr. Hamilton, the inspector of lighting, to prepare a report on the requirements of the leading thoroughfares for presentation to the Watching and Lighting Committee, with a view of making recommendations for the extension of the system. The Electricity Committee had offered to supply the current for street lamps at the rate of £14 per lamp for all-night lighting, or £12 per lamp should each alternate lamp be extinguished at 11.30 p.m., on the understanding that the minimum number of electrically lighted street lamps in the city be raised to 400.

Grays.—The Council is still considering proposed sites for the electricity works.

Hendon.—The Council has before it a letter from English Industrials, Limited, offering to take up the provisional order. Mr. Hammond's scheme will shortly be placed in the hands of the Council.

Hereford.—A member of the Town Council seems to have an exaggerated notion of his duties in that capacity. The Council has been for some time past pledged to carry out an electric lighting scheme, and, as we have already intimated, contracts have been placed. The Councillor in question, however, does not satisfy himself with merely expressing his conviction that the scheme will result in financial loss to the town, but, according to the report of the Electric

Lighting Committee, he has issued a circular to the citizens "with the intention of inducing them not to take the electric light." The committee says that although it does not wish to attach undue importance to the incident, it believes it to be entirely without precedent for an individual member of the Council to attempt to frustrate an undertaking to which the Council has already committed itself. The committee's protest led to a discussion at the last Council meeting, and the Councillor in question repudiated the suggestion that he had any idea of attempting to overthrow the scheme, but he said he had in consideration what it was going to cost the ratepayers. He had no intention of inducing any persons not to take the light. Whatever the general opinion of the Council may have been regarding this explanation, the meeting by resolution endorsed the committee's protest by adopting its report.

Kettering.—The Council is inquiring Prof. Kennedy's fees for advising *re* an electric lighting scheme.

Kilmainham.—Mr. C. W. Sax has explained to the Council the terms upon which the Municipal Electric Supply Company, Limited, would be prepared to supply the township with electricity.

Leatherhead.—A poll of the residents shows 21 in favour of the electric light, 65 against, and 23 neutral. The Council has washed its hands of the affair, for the present at any rate.

Liverpool.—At last week's Council meeting Councillor Higginbottom said that the Electric Lighting Committee had decided not to extend electricity for street lighting, as incandescent gas would do all that was required.

London, E.C.—In the House of Commons on Monday Mr. Ritchie obtained leave to bring in a Bill to confirm a provisional order made by the Board of Trade, under the Electric Lighting Acts, 1882 and 1888, relating to the City of London, and one of the Standing Orders having been suspended, it was read a first time.

Llanelly.—At the meeting of the Estates Committee of the Llanelly Borough Council it was intimated that two applications had been received—one from a London firm—in reference to the willingness of the Council to sell their electric lighting provisional order. After discussion it was resolved to invite representatives of these firms to attend the Council meeting.

Lynn.—Prof. Robinson's report on the question of extending the mains and public lamps, and a loan of £2,500 is to be raised, after it has been sanctioned by the Local Government Board, for carrying out the work he recommends.

Monmouth.—As the electricity works are ready to commence operations, the staff has now been appointed. Mr. G. Dean, clerk of works, has been appointed chief engineer and Mr. T. Blake is second engineer.

Newington.—The contractors and consulting engineers who have been responsible for the equipment of the electricity works, sent an invitation to the Council to meet at dinner to celebrate the opening of the electric light station. But upon the intimation of the fact at last week's Vestry meeting, the black-gloved hands were crossed upon the worthy breast, and Newington was shocked! Something was said about the motives which prompted the contractors, and even the morality of public dinners did not escape attention. The voting was 25 against accepting, and 23 in favour, the chairman's vote being included in the majority. Newington will have no banquet, and the electricity supply works will be deprived of the benefits accruing from so excellent an advertisement.

Newport.—At the last meeting of the Electricity Committee the borough electrical engineer submitted his usual monthly report upon the condition of the plant and machinery, which was considered satisfactory. The new buckets have been fixed to the condensers, and are now working satisfactorily. All the suction and delivery valves on the old pumps have now been repaired, and are in good working order. The switch gear was transferred to the new board on the 14th inst. He explained a failure in connection with the new arc lamps, which are still in the hands of the contractors. He also gave a comparison of the capacity of the plant, with the number of lights connected, showing the plant, exclusive of the reserve plant, to be overloaded. A return, showing the financial result in respect of the fourth year's working up to March 31st, 1899, was submitted, of which the following is a summary:—

Year.	Gross profit after payment of working expenses.	Interest on loans.	Sinking fund.	Deficiency after payment of interest and sinking fund.
Fourth year ending March 31st, 1899 ..	£2,344	£1,560	£1,077	£293
Third year	1,716	1,362	788	434
Second year	866	1,060	768	962
First year	244	927	707	1,410

The office manager submitted his report as to the progress of the business for the month of April based upon the number of units generated, showing a satisfactory rate of increase. He also presented a report of his canvass during the past month, from which it appeared that he had obtained orders for new connections equivalent to 620 8-C.P. lamps, bringing the total connected and on order to 28,726 8-candle-power lamps. The borough electrical engineer stated that it would be necessary to provide rubber mats both at the back and front of the switchboard, in addition to a wood block flooring which is about to be laid. It was resolved that the matter be left to the sub-committee to deal with. The consulting electrical engineer reported on the progress and present position of the various contracts for the extensions and that the temporary sub-station at Maindel, authorised at the last meeting, was now in working order. The office manager reported that he had received several applications from frontagers to Clarence Place, Millman Street, and Carlisle Street, to be supplied with current at once, and it was resolved that the necessary arrangements be made forthwith.

Oldham.—Messrs. W. B. Haigh & Co., Limited, have secured the order from the Oldham Equitable Co-operative Society for the lighting of their new central premises for two steam dynamos in addition to the one they have on order for the same society. Each of the two sets consists of a Willans compound high-speed engine of 60 H.P., coupled direct to a 37-kw. dynamo. Each dynamo is capable of lighting over 1,300 8-C.P. lamps.

Oswestry.—Mr. Hawtayne attended a special Council meeting on 13th inst., to discuss further the question of purchase price of the Electric Light Company's undertaking which Mr. Hawtayne had valued at £8,320, whereas the company asked £11,750, plus the cost of machinery subsequently purchased. It was resolved to acquire the undertaking at a sum not exceeding £11,750. A poll of ratepayers was, however, demanded upon the question.

Oystermouth.—The Oystermouth District Council (Swansea Bay District) have decided, after considering the question of lighting the district by electricity, to communicate with the chief electrical engineers as well as those who have already been in communication with the Council, in pursuance of an advertisement inviting tenders and particulars for a scheme for electric lighting.

Poplar.—There was a quibble at the last meeting of the Board of Works regarding the rates of wages to be paid by Messrs. Crompton & Co. Several members protested against such interference, one remarking that the time had come for the Board to conduct its own business, and not for the A.S.E. to dictate what rates of wages should be paid.

Portsmouth.—At Tuesday's Town Council meeting, the Electric Lighting Committee submitted the balance-sheet for the year ending March 31st last, and recommended that £1,475 be set aside as a reserve fund, that £1,000 be paid to the credit of the urban account, and that £64 16s. 10d. be reserved to cover bad debts. The superintendent (Mr. E. Price), in his annual report, states:—"During the year ended March 31st last we have increased our lamp connections for private lighting more than during any previous year. We began the year with 22,308 lamps, and finished with 29,590, an addition of 7,282 lamps of 16 C.P. During the year 1897-8 we sold 981,273 units at a cost to produce of 1·88d. per unit. During 1898-9 we increased our output to 1,225,000 units, at a cost of 1·77d. per unit. This increased output has had a salutary effect upon the cost per unit, as was to be expected; but the reduction would have been greater had the cost of coal remained constant, if we had secured a larger proportion of domestic lighting, or if we had increased our public lighting. During the year 1897-8 the cost, 1·88d. per unit, included ·64d. for coal. Last year the coal has increased to ·74d., and this increase, I take it, is caused, primarily, by the increased cost of coal generally, but more particularly by our increased demand on what may be regarded as a local product. The average cost per ton in 1897-8 was 11s. 1½d, in 1898-9 it rose to 12s. 9½d." Attention is called to the desirability of getting a longer hour consumption. This, Mr. Price considers, should most easily be done by undertaking public lighting by incandescent lamps in lieu of gas, and by securing the domestic lighting. With the latter, fewer lamps may be on at a time, but the average use is much longer, and throughout the year some lamps in each installation are used daily, whereas in many shops the lamps are not used at all during the summer months. At the present time the mains pass hundreds of private houses inhabited by persons who are tenants for indefinite periods, who naturally object to pay for improving their landlord's property, and these tenants (Mr. Price says) are the very people we ought to have connected. "I am sure (he adds) that a great mistake was made as regards the prosperity of this undertaking when it was decided that 'free wiring' should not be admitted, and until some system of this kind is adopted, I feel certain that our load factor will not improve."

Plumstead.—The *Woolwich Herald* says that the Electric Lighting Committee has recommended the Vestry to engage Mr. Arthur Wright immediately after the provisional order has been confirmed, as consulting engineer at £600 per annum for five years, the Vestry providing the necessary staff and office assistance.

Plymouth.—From a local paper we gather that the electricity works are completed, and that the fires are to be lighted at the end of this week.

Rickmansworth.—There is a proposal before the District Council to apply for a provisional order.

St. Anne's.—The Urban Council has engaged Mr. Tonge, the electrical engineer at Preston, to report, for a fee, upon Mr. Tiddeman's scheme, recently submitted to the Council. A proposal to ask the Blackpool Corporation upon what terms they would supply current to St. Anne's has not been carried.

The Council has entered into a contract with Messrs. Goddard, Massey & Warner for a dust destructor.

St. Helens.—The Electric Supply and Tramways Committee has considered the terms offered by two companies *re* electric free wiring, and an arrangement is to be entered into with Messrs.

F. W. Smith & Co. An order has been given to Messrs. Chamberlain and Hookham for 150 meters, and to the Reason Manufacturing Company for 150 house fuse boxes. A sub-station is to be erected at Eccleston Hill. The borough electrical engineer, Mr. Highfield, is to act as arbitrator in respect of the destructor contract, in the place of the late Dr. John Hopkinson. The new power station at Cropper's Hill is now nearly completed, and the Town Hall plant is to be removed there. During May 6,463 units were sold for 3,687 8 C.P. lamps connected, against 4,560 units and 3,437 lamps last year. A trial run of the new electric trams will be made in about a week.

Sale.—The Electric Lighting Committee is in negotiation with the Altrincham Electric Lighting and Power Company, Limited, with the view of obtaining their terms for supplying electric light to the district.

Salford.—It is complained that the erection of the new electric light station on the side of the canal and adjoining the Corporation stoneyard, Strawberry Hill, Pendleton, is not making much progress owing to delay on the part of the Local Government Board in passing the plans and sanctioning the borrowing of the necessary loans required. Applications by the score have had to be declined, and another 18 months or longer will elapse before they will be in a position to increase the supply of current. It is doubtful whether the new station will be ready by the time the tramway system becomes the property of the Corporation. Many large concerns, despairing of obtaining motor power, are putting down their own electric plant. The present station at Wallness Bridge is producing as much electrity as it possibly can, but, says the *Salford Chronicle*, 50 per cent. of the current is lost, owing to the alternating system which was originally adopted and the defective condition of the mains.

The Council has adopted amended plans for the erection of a battery sub-station, offices for the new generating station, &c., in connection with the electric lighting plant of the Corporation, and application is to be made to the Local Government Board for sanction to borrow the sum of £5,500.

Sandown (I.O.W.)—A syndicate is anxious to take over the electric lighting order.

Seaford.—A special meeting of the Urban Council was held on Saturday, when it was unanimously resolved to approve of a provisional order being granted to a syndicate for the supply of electric lighting for the district on condition that a satisfactory purchase clause be inserted.

Sheffield.—The amount payable for local rates on the machinery and cables of the electric light undertaking having been increased from £393 per annum to £1,956, the Committee have decided to appeal against the assessment. The Electric Light Committee recommend the appointment of Mr. T. J. Ballard, of the Wandsworth Electric Lighting Station, as superintendent of mains at a yearly salary of £250, in the place of Mr. A. Lucas, who recently resigned. The Committee have instructed the general manager to request Mr. Robert Hammond to report fully as to whether there is at present in existence any system for the supply and distribution of electricity applicable to the city of Sheffield which would, having regard to the capital expenditure already incurred, and to all the other circumstances of the case, be more advantageous than the system now in operation, or whether any modification of the existing system of supply is advisable and practicable, and further, on what lines the future development of the undertaking should proceed.

Shoreditch.—Plans are being prepared for two new underground sub-stations. In response to applications for current, the mains are to be extended along St. John's Road.

Southport.—The report of the fourth year's working of the electricity undertaking shows a net profit of £2,027 as against £643 the previous year, and it is being disposed of as follows:—£620 in aid of rates, £203 to wipe off a disallowance by the Local Government Board, and £1,204 in the reduction of capital.

Swansea.—The Local Government Board has sanctioned the £52,000 loan for the electricity scheme.

Torquay.—Torquay is to be congratulated upon the success which has attended the working of its municipal electric lighting undertaking. A report submitted to the Town Council last Wednesday week showed that the total capital outlay was £24,959, which is £2,659 in excess of the amount borrowed for the work. The greater part of the extra expenditure was due to changes effected in the central station to allow of future extensions at little cost, and to outlay upon spare materials taken over and since utilised. When the works were opened on March 31st, 1898, there were 3,310 8-C.P. lamps connected for private lighting, while on May 30th last the number was 5,644. The number of consumers has increased from 55 to 140, and there are applications in hand from 15 consumers for 529 8-C.P. lamps. In the year ended March 31st, 1899, the number of units generated was 160,681, of which 80,490 were used for public lighting, 67,909 were sold for private lighting, and 12,282 were expended on excitation. The financial statement showed that on an income of £2,839 there was a gross profit of £1,057. The charges for interest and sinking fund amount, however, to £1,188, so that there is an actual deficit of £130. In order to meet the deficiency on capital account and provide for future extension, the Electric Lighting Committee recommended the borrowing of a further sum of £10,000. Alderman Kerswill, in moving the adoption of this recommendation, said the expectations of the committee had been more than realised, and they looked to the future with high hopes. Much of the success achieved was due to Mr. Storey, the electrical engineer. Several members of the Council, including the mayor (Mr. W. Beavis) expressed hearty satisfaction with the result, and the recommendation was carried unanimously.

Tunbridge Wells.—In its agreement with the Free Wiring Company, the Lighting Committee has not granted a monopoly, and has declared its willingness to enter into an identical agreement with any local tradesmen. Plans are to be prepared for further extending the electricity works. Incandescent electric lamps are to be substituted for the present gas lamps where electric mains are laid. This involves the erection of 260 additional electric reflector lamps, and will leave 363 lamps to be lighted by the company.

Walker and Wallsend.—On Wednesday, Thursday and Friday a Select Committee of the House of Commons, under the chairmanship of Sir Henry Fletcher, was engaged in considering the Bill promoted by the Walker and Wallsend Union Gas Company, to produce and supply electricity over the Walker, Wallsend and Willington districts, and to erect works, &c., for that purpose, and also the Provisional Order Confirmation Bill of the Walker Urban District Council to supply electricity within their own district. A new point in the Bill was the power asked by a gas company to supply electricity.

Mr. Fitzgerald, who represented the gas company, called evidence to show that it was desirable that there should be an electric supply throughout the district, more especially for motor power. It was considered by the large firms in the district that the proposal to supply electricity by means of the company was better than the proposal to supply it by means of the Walker Council. If the power could be supplied in the manner that the company proposed and expected, it would be a great advantage to the public.

Mr. Wedderburn, who with Mr. Pembroke Stephens represented the District Council, contended that the gas company's Bill was without precedent, and was, moreover, unnecessary. As to the Walker provisional order, he thought there could be no question but that the Committee would confirm it, because there was no instance in which any Committee of either House had ever refused to confirm a provisional order granted by the Board of Trade to a local authority except where there was an existing company having electrical powers in the district. In this case, moreover, there was no objection by the company to the Council having the provisional order. The position as regards Wallsend and Willington under the Bill was that the gas company had agreed that in the event of the Wallsend and Willington authorities thinking fit in the future to apply for electrical powers the gas company would not oppose them. Under those circumstances, it was absolutely impossible that the Walker Council, who had already applied for such powers, should be placed in a worse position than the other two districts.

Mr. Compton Bickett, a member of the committee, said the gas company had agreed to withdraw their opposition to the Council's Bill if the Council would withdraw their opposition to the company's Bill.

Mr. Wedderburn said the question was whether the gas company should be allowed at the start to compete with the Walker Council for the supply of electricity at Walker. The company had no claim to come forward for such a power, and the fact that they were a gas company ought to tell against them. As to any opposition to the Council's Bill from the ratepayers, it had only come from those ratepayers interested in the gas company. There was no precedent for conferring electrical powers upon a gas company, and only that session such a proposal in another district had been refused by the Board of Trade. The gas company wished to compete at the start with the Council to drive them from the field. They were acting solely in their own interests as gas purveyors, and were afraid that if the Walker District Council were the sole possessors of the electric light, the consumption of gas would go down. To say that they were acting in a pseudo philanthropic spirit, anxious to supply electrical consumers cheaply, was to say something which was inconsistent with their position as a gas company. While generally competition was a good thing, yet there must be room for it, and he maintained that the local authority ought to have a fair chance at the start of satisfactorily supplying electricity at a cheap rate. They could borrow at a cheap rate, and although during 25 years they would be saddled with a 6 per cent. interest and sinking fund, yet at the end of that term they would be able to supply more cheaply than any company could hope to.

Mr. Fitzgerald said the substantial question for the committee to consider was, which of the competing Bills should be passed, or whether both should be allowed to supply. There was an exceptional matter in this case, that for the first time they had a district in which the supply of electricity for power purposes was certain to be the principal supply. In every other case that Parliament had had to deal with it had been lighting, which was the principal source of supply, while the supply of motive power had been comparatively small. Power at Walker would be required by 16 large works, and 15 of these had presented petitions against the Bill of the District Council. With regard to the Walker Council Bill, there was no clause with respect to the lowering of the price, and until they had first produced 6 per cent. for the sinking fund and 5 per cent. profit, making 11 per cent. in all, their maximum charge was placed at 8d. per unit. Then the Council would have no power to replace the gas street lighting by electricity, because they were bound to accept the gas company's supply under the Companies Act of 1884. Under certain conditions as to the putting up of lamps and the discontinuance during the summer months, the company were not afraid of competition but the Council were, because they knew the company could supply better and cheaper, and would drive them out of the field.

After considering in private, the committee decided to pass the preamble of the gas company's Bill as regarded Wallsend, Willington

and Willington Quay, but not with respect to Walker. They also decided to pass the Bill of the Walker Council confirming the provisional order. The clauses of the Bill of the gas company were afterwards adjusted.

A Select Committee of the House of Commons has been considering the Walker and Wallsend Union Gas Company (Electric Lighting) Bill and the Electric Lighting Provisional Orders (No. 7) (Walker) Bill. The first measure involves a novel point, inasmuch as the local gas company is seeking power to supply the electric light as well as gas.

Walsall.—The Electric Lighting Committee reported to the Town Council on Monday that the number of consumers supplied on May 31st was 143. The total output from the main generators was 13,134 units for the month.

Warrington.—The Electric Light Committee has decided not to entertain a proposal of the English Industrials, Limited, to take over the electric lighting order.

Wellingborough.—The Electrical Power Distribution Company has laid a scheme before the Urban Council, under which it proposes to put down works for the supply of electricity for lighting and power purposes in the district. The company would adopt a low pressure system. The Council met some few days ago to consider the scheme.

West Hartlepool.—The Electric Light Committee reported to the Council that Prof. Kennedy had submitted correspondence with Messrs. Crompton & Co., in which they claimed for increased cost of materials owing to the delay in completion of the buildings, and also for expenses incurred in warehousing the machinery, and keeping the same in order. The several matters were referred to Prof. Kennedy to communicate with Messrs. Crompton and report.

Weymouth.—After considering the report of a deputation to Brighton and Tunbridge Wells, the Town Council has decided to appoint an expert to advise as to cost and the best means of lighting the town by electricity.

Whitehaven.—The Electric Lighting Committee of the Whitehaven Corporation have decided to recommend Mr. J. Gray Scott, of Bradford, to the vacant post of surveyor and electrical engineer, rendered vacant by the removal of Mr. C. M. Mayson, to Charing Cross.

Wingate.—The Parish Council is lighting the main streets of Deaf Hill and Trimdon Foundry with electricity. The Deaf Hill Colliery Company will provide a new engine and dynamo to supply current at 220 volts. The contractors are Messrs. Reid, Ferens & Co.

Wolverhampton.—The Lighting Committee have just issued their report and balance-sheet for the year ending March 31st last. In it the Committee express pleasure in being able to report that the operations of the year have again been successful. A profit of £1,004 5s. 10d. has been made, after payment of interest and sinking fund charges. Of this amount £588 0s. 6d. has been applied to clear the deficiency on the working of the previous years, and the department has now in hand a sum of £416 5s. 4d., which it is proposed to carry forward to revenue account for next year's working. The committee call attention to the satisfactory growth of the undertaking, the number of consumers, the number of lamps connected, and the amount of electricity sold since the commencement of supply, these being as follows:—

Year.	No. of consumers.	Percentage increase.	No. of lamps connected.	Percentage increase.	No. of units sold.	Percentage increase.
First.	113	..	8,941	..	191,701	..
Second.	154	36 %	11,307	26 %	224,709	17·2 %
Third.	208	35 %	14,151	25·2 %	291,233	29·55 %
Fourth.	276	32·7 %	19,932	40·8 %	371,830	27·5 %

Financial Result.

	£ s. d.		£ s. d.
First year and three months Loss	1,403 9 3		
Second year .. .. .. Profit		..	225 14 6
Third year .. .. .. Profit		..	589 14 4
Fourth year .. .. .. Profit		..	1,004 5 10
	£1,403 9 3		£1,819 14 7

There are, the committee state, satisfactory signs that this progress will be continued, and that electricity, as an artificial illuminant, is gradually becoming more popular in the town. There is now a demand arising in the better residential districts, to meet which the committee are extending their area of supply. It is interesting to note that many of the large new buildings erected in the town are being lighted electrically from the Corporation mains. Up to the present date, two alterations have been made in the tariff charged to consumers. The first of these resulted in 71 consumers, out of a total of 164 (or 43 per cent.), obtaining a rebate. The second alteration has resulted in 176, out of a total of 267 (or 65 per cent.), obtaining a rebate. The average price paid by the consumers for lighting during the past year was 5·24d. per unit, and for power and heat 1·7d. per unit. The committee add that none of the recent breakdowns are, in their opinion, in any way attributable to neglect on the part of the staff, but that a certain risk of accident is inseparable from the high tension continuous current system. The conversion of the system to the three-wire principle, the expenditure for which was recently sanctioned by the Council, will, when complete, provide such an amount of spare plant and electrical storage as will enormously reduce the possibility of further breakdowns.

At Monday's Council meeting the chairman of the Lighting Committee congratulated the Committee and the town on the very satisfactory result of the last year's working. They were absolutely now out of the wood, and the undertaking was a paying concern. They had to spend £800 in the next year out of the revenue on alterations, so that the balance of £416 in hand was really mortgaged; but he had confidence in being able to present an even better report next year. The profit they had made was equivalent to 7½ per cent. on their capital.—The Mayor said they should also congratulate the chairman of the Committee. The report was adopted by the Council, as was also a recommendation of the Lighting Committee that it be left to the discretion of the Sub-Committee to authorise the engineer to purchase an additional set of balancing transformers at a cost not exceeding £900, if, in his opinion, such a step should be rendered requisite by reason of the non-delivery of the storage battery. The chairman also proposed the acceptance of the tender of Mr. J. Orme Brettell for the new battery.

Yarmouth.—The Town Council decided on Tuesday to borrow £27,000 to extend their electric supply plant, and to spend £4,000 at once. Owing to the success of the installation, the Council resolved to reduce the charge per unit to 6d. for the first hour, and 4d. per hour after, to customers consuming 4,000 units and under per annum; and to 6d. and 3d. respectively to customers taking more than 4,000 units. The Brighton or Maximum Indicator System was adopted, but its use made optional. Information from 19 other towns was to the effect that it had been tried and found very satisfactory.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The contractors, Messrs. M'Adam & Sons, on 5th inst. commenced to lay the track for the electric tramways.

Accrington.—An agreement has been duly entered into under which the Accrington Steam Tramways Company sell their undertaking to the British Electric Traction Company. The terms are quoted in a Preston paper.

Bath.—A meeting of the Tram Committee recommends the Council to oppose the application of Messrs. Davis, Ellis, Hasken and others for a light railways order, and to apply for an order itself next November.

Brighton.—The Tramways Committee of the Town Council have presented a report in which they state that they have given careful consideration to the question of the best means of providing a system of tramways for the borough. In accordance with the arrangement made by the Council, the Mayor and other members, accompanied by the borough surveyor, visited the cities of Rouen, Paris, Brussels, Boulogne and Dover, for the purpose of inspecting the tramway systems there. Certain towns in the North of England had also been visited. The committee had had several meetings with reference to the routes along which the proposed trams should run in Brighton, and recommended eight lines for which the Council should apply to Parliament for powers. The committee had considered the question of the motive power to be used for the purpose of the tramways, and were unanimously of opinion that the tramways should be worked by electricity. They had come to the conclusion that the overhead trolley wire system is the best suited to the requirements of Brighton. The committee were also of opinion that double lines of track should be provided wherever practicable. With regard to the cost of the scheme, the committee reported that the details of the system were not sufficiently determined upon to enable them to give the Council any exact information, but as soon as the necessary details had been decided upon the estimates would be prepared.

Coatbridge and Airdrie.—At a meeting of the Tramways Committees of the Coatbridge and Airdrie Town Council a subcommittee of six was formed to obtain information to form a trust and generally arrange as to how best the tramway scheme could be carried out and the tramway constructed.

Crosby.—The District Council has resolved that the surveyor shall arrange with Mr. T. B. Cottrell, of the Liverpool Overhead Railway Company, to furnish specifications and estimates for rails, &c., and also that the surveyor prepare estimates and specifications for the roadway along which the electric trams will proceed.

Derby.—The Tramways Committee report that they have had under consideration a joint report of the borough surveyor and the electrical engineer upon the subject of electric traction, and the members were visiting and inspecting the tramway systems adopted in other towns.

Liverpool.—Last week Mr. Rutherford, of the Tramways Committee, said that during the six months ending May 31st the receipts were £14,168 in excess of the corresponding period last year, and they had carried 7½ million passengers more. As regarded the electric traction, the receipts during the four months were £18,463, and the number or passengers carried was 3,908,000.

(*Continued on page* 985.)

ELECTRIC LIGHT AND TRACTION ENGINES.

No. I.

THE causes which have so much delayed the progress of electrical work in England, and more particularly of electric traction work, are being, we fully believe, gradually removed, and it is greatly to be hoped that with the growth of electric traction, English engine builders will no longer suffer themselves to be ousted from their own market by American engines. If foreign made engines are to come to England, we should prefer American to any other, but we see no necessity for the continuance of the practice. The advanced state of electrical traction in America is no doubt responsible for the existence of a special class of traction engine which has passed through its experimental stages to arrive at its present fairly satisfactory condition. It should be the endeavour of our own makers to see to it that this experimental stage is not required in England. America has done the necessary experimenting, and is consequently reaping the profit from orders for traction plant sent from here.

With electric traction spreading as it now is in Great Britain and Ireland, it is high time that our own engineers exerted themselves. The greatest credit is due to the firm of Willans & Robinson for their foresight and energy in preparing to receive their share of the coming business.

They will have their reward. To other makers we would say that the present busy time in general work may not—in fact, will not—endure for ever, and traction orders will then be the mainstay of the market. We propose from time to time to illustrate and describe the productions of English makers. The country which has engined the Atlantic liners and whose steamships are in every port will not be found wanting when it puts its hand in earnest to the comparatively small effort of electric traction.

Americans have had the lead in our markets, and will keep this lead just so long as English engine manufacturers please to let them. There ought to be no necessity, either for time or any other reasons, for the coming orders for traction plant to be any longer sent out of our own country.

American engines are good, but far from perfect. The craze for rapid work, of which we read so much in respect of American tools, has been one reason for Americans obtaining beautiful material on which to work. But material which is beautiful in the boring mill is not the sort of stuff that English engineers have been accustomed to use for steam cylinders. Now, American cylinders are almost invariably soft. It is so, and long has been so to our knowledge, in their locomotives, and the same fault occurs in their stationary work. Soft cylinders do not conduce to good running or economy. There are other faults we need not mention, some of which are common to others besides American made engines. There is still room for great improvement in engines for traction work, and it is folly to allow the market to be monopolised by foreign makers. After all, there is nothing very special in the design of an engine for traction. True, the governor must provide for sudden changes of load of large extent. As regards the effect of such changes, probably this has been exaggerated. At any rate, American engines are not made in any sense specially strong for traction work, and so little is thought of the effect of sudden load changes, that the whole fly-wheel action is allowed to pass through the crank pins to the generator. This would not be the case if the stresses were so enormous as they are commonly supposed to be—not that such an arrangement of fly-wheel is to be specially commended.

We have selected, for the purpose of this first article, the generating station of the Waterloo and City Electric Railway, whose equipment possesses the distinctive feature of being English-made, Messrs. G. E. Belliss & Co., Limited, being responsible for the engines, and Messrs. Siemens Bros. for the generators, to which they are directly coupled. We are indebted to Prof. Kennedy, and the contractors, for permission to take the accompanying photographs, and doubtless at a later stage we shall be afforded an opportunity for describing the line itself. The views which we are able to give, however, answer the purpose of this article, the object of which, as we have stated, is to bring before our readers some specimens of what our own engine-makers are doing in the way of engines for electric light and traction work.

From one of the photographs it will be seen that there are at present six sets of plant in position, but in the foreground there is plenty of space left for installing further machines according to requirements. Another view shows the station looking toward the switchboard, while in a further picture we illustrate a single set as it now stands in position.

The engines are of Messrs. Belliss's Tec/4 standard three-crank type, with a complete tandem compound engine working on each crank. They are designed to exert 300 I.H.P. at ordinary full load, and 360 I.H.P. as a maximum at a speed of 380 revolutions per minute and 150 lbs. pressure at the engine stop valve. The working parts of the engines are enclosed by a casing to keep out dirt, and to permit of Belliss's patent system of forced lubrication to the bearings. This system of lubrication is well adapted for electric traction, as it is essentially automatic in its operation, and works with a minimum of attention. Moreover, we are given to understand that a hot bearing is practically unknown, which, it is thought, can hardly be said of open engines fitted with ordinary lubrication.

The engines are fitted with massive fly-wheels and highly sensitive governors of the throttle valve type, as perfected by Messrs. Belliss. The action of these governors is exceedingly good, and with the railways in full operation, with the load on the dynamos constantly varying from 50 to 350 amperes or more, the speed indicators remain perfectly steady and almost immovable. Quite recently when a reading of the tachometer and ammeter was taken in connection with one of the sets every half minute for 10 minutes, the following results were obtained:—

No. 1 ENGINE. No. 639 D.E.

Time:—1.11 to 1.21 p.m.

Mean boiler steam 160 lbs.

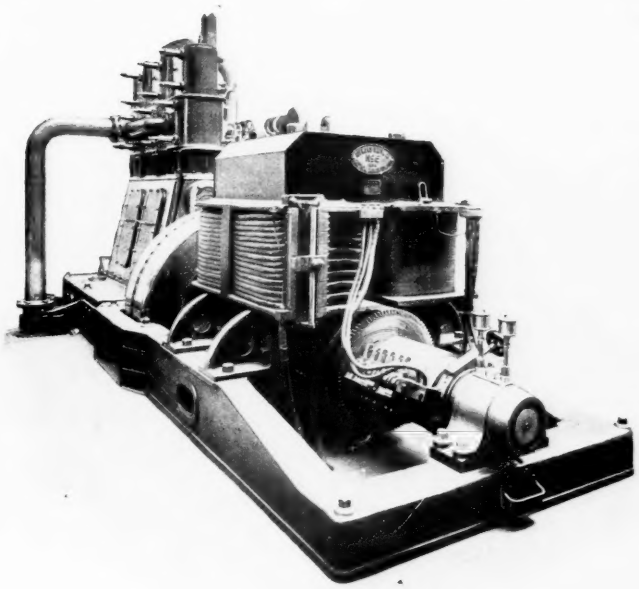
Amperes.	Speed (tach.
300	384
310	384
330	384
80	387
50	387
85	386
50	387
50	387
150	385
130	386
145	385
110	386
110	385
165	384
210	384
265	383
300	384
312	384
330	383
140	386
70	387

The speed corresponding to the full load of 380 amperes was 383 revolutions. It will be noted that the maximum deviation from the mean speed for any change of load is only one-half of 1 per cent., a performance which the makers believe to establish a record for traction work.

The speed of revolution, 380 per minute, is also noticeable at a time when much slower speeds are being strongly advocated in the interests of the American type of engine. We understand that no troubles have resulted at the Waterloo and City station that may be attributed to the speed of revolution adopted, which, in addition to being favourable to even turning and assisting the governing, has the important advantage of reducing very much the space occupied by the machinery. The Mackintosh and Seymour sets at the Glasgow electric tramways, of approximately the same power, occupy a floor space, *i.e.*, extreme length multiplied by extreme breadth, of about $1\frac{1}{8}$ square feet per electrical horse-power. The Waterloo and City sets measured in the same way, take up only half a square foot per electrical horse-power. In other words, the quick-revolution sets can be got into an engine room of about half the size. This is an important consideration, where space is so valuable as it is in London and other large towns. The smaller dimensions should also have an important bearing upon the first cost of the engine and dynamo.

The dynamos are of Siemens's standard H.B.27 40 type, specially arranged to meet the exacting requirements of electric railway work. The normal output is 380 amperes, 530 volts (201 kw.), at 380 revolutions, but the machines are capable of carrying a large overload for a short time. They are compound wound, so as to give 500 volts on open circuit, and the series bobbin is arranged so that the amount of over-compounding can be readily adjusted.

The armature is of the smooth core drum type, wound with compressed stranded copper bars very carefully insulated, and is carefully ventilated. The commutator is $15\frac{1}{2}$ inches in diameter, and long enough for six 2 inches $\times \frac{3}{4}$ inch carbon brushes. The segments are of hard rolled copper, accurately milled to shape, and are thoroughly insulated with mica. The field magnets are of massive construction, and consist of high permeability mild steel tooled all over and accurately finished. They are supported according to the usual way for this type of dynamo, viz., by gun-metal brackets resting on the bed-plate and gun-metal feet grouted into the concrete foundation. On account of the extra heavy fly-wheel, a bearing is fitted between the end of the armature and the coupling to fly-wheel.

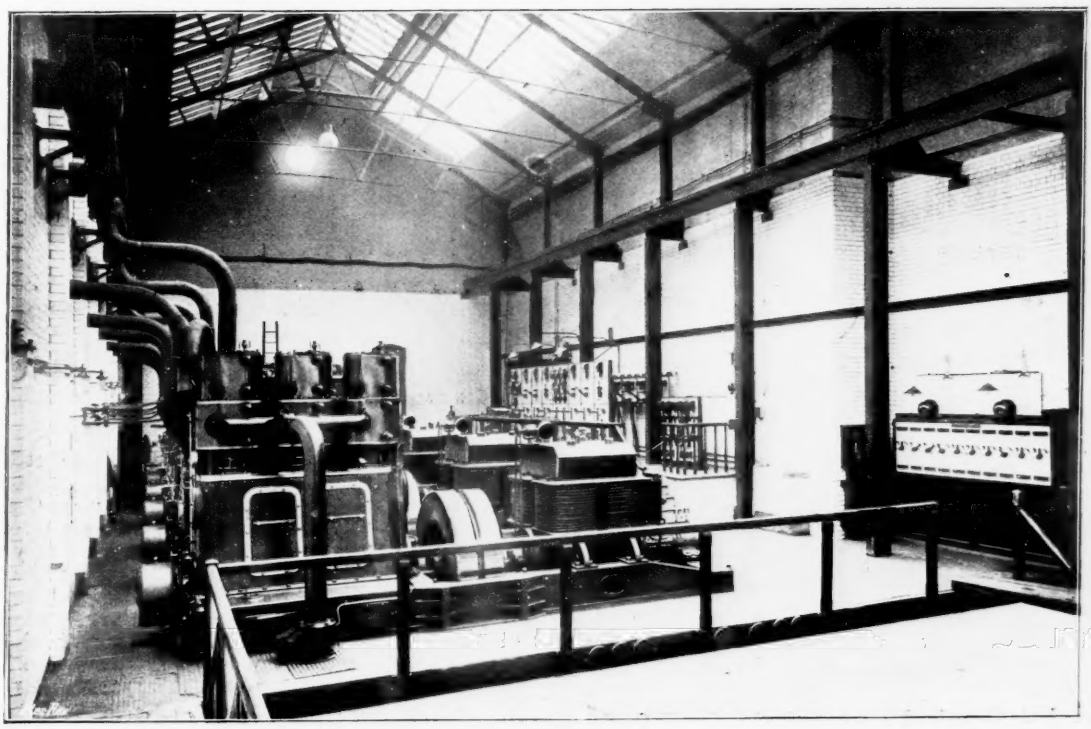


WATERLOO AND CITY RAILWAY: SINGLE SET.

It is of interest to mention at the present moment that the experimental section of the Metropolitan Underground, the electrical equipment of which is now being carried out under the supervision of Sir J. Wolfe Barry and Sir W. H. Preece, is to be worked by means of two Belliss-Siemens generators, which are practically duplicates of the Waterloo and City sets.

The municipal tramway power plant at Blackburn, which we described in our issue of March 24th, 1899, also comprises Belliss engines and Siemens dynamos. There are two sets, each comprising a Belliss E.C. 10 self-lubricating engine, coupled direct to a Siemens H.B. 24 32 compound wound type 120 kw. The machines are arranged for tramway work at 550 volts, or lighting work at 250 volts. The engines are of the maker's compound single eccentric type, with one high and one low pressure cylinder, working on opposite cranks. The engines are designed for an output of 200 I.H.P. at ordinary full load, rising to 250 I.H.P. as a maximum, running at a speed of 380 revolutions per minute.

The engines were recently reported to be running well, and giving perfect satisfaction to the engineer-in-charge. The



WATERLOO AND CITY RAILWAY: VIEW LOOKING TOWARD SWITCHBOARD.

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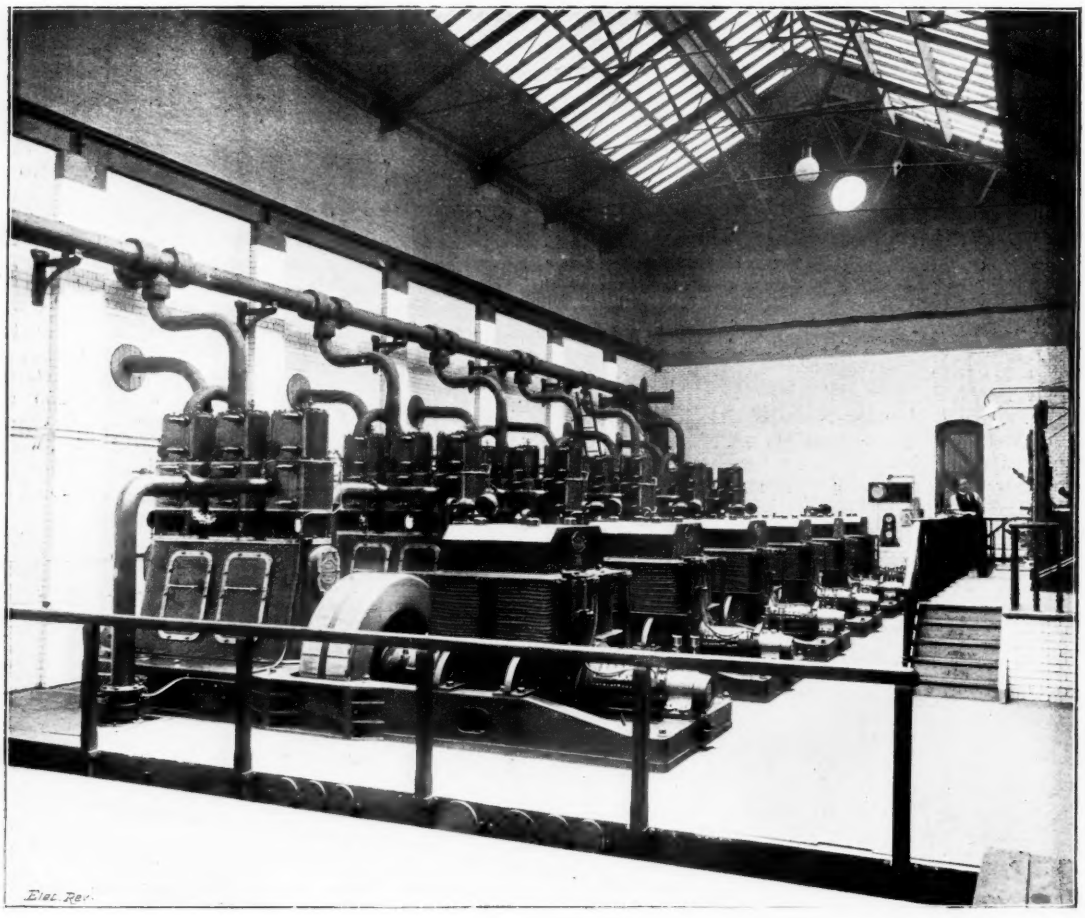
governing of the engines was stated to be perfect, and never required adjustment from the start to finish of the day's run, and this although the load varied from zero to 240 amperes and more. On one occasion a very bad short occurred, the automatic cut-out failed to act, the ammeter needle went right over against the stop, and the engine was brought up dead, and all this, we understand, without any apparent damage to the engine or machine. Such satisfactory results must lead engineers to place great confidence in the plant.

As to other work of this character carried out by Messrs. Belliss, we understand that they have supplied numerous other sets for electric traction, and combined traction and lighting, making altogether a total of about 16,000 H.P. of engines supplied, or in course of construction, for traction purposes.



Waterloo and City Railway: General View.

THE NIAGARA SUSPENSION BRIDGE.

Last week we gave a couple of illustrations showing the new electric railway suspension bridge in course of construction over the Niagara River. We are now able to give a view of this exceedingly interesting structure when nearing completion (see page 983). Full details will be found in our last issue.

WATFORD ELECTRIC LIGHTING.

The official inauguration of the electric lighting station of the Urban District Council of Watford, calls attention to the rapid progress which is being made by electric lighting among the minor municipalities and urban districts, with corresponding benefit to all branches of the electrical profession. It is especially noteworthy that electric lighting of the public streets forms a prominent feature in this class of work—a fact which, while it indicates a progressive spirit and a desire to move with the times, in no small degree contributes to the success of the scheme, by providing the works with a steady and paying load from the outset, and by ensuring a reasonably good load factor.

The first steps were taken in June, 1896, when the Council instructed Mr. W. C. C. Hawtayne to report on the whole question, including the public lighting of the entire town. In his report Mr. Hawtayne recommended the adoption of a high pressure alternating current system, with a low pressure distributing network, and estimated the probable cost at about £19,000 if the buildings were combined with those of the new sewerage works, which the Council was then about to construct, or about £21,000 if the two undertakings were not combined.

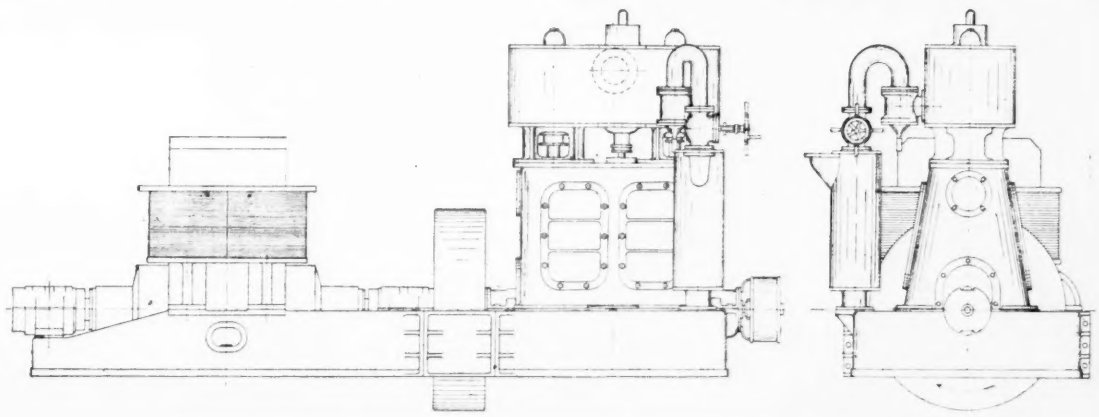
Mr. Hawtayne's scheme was approved of by the Council, and in the following year a provisional order was obtained, and tenders invited; these proved satisfactory, and fully bore out the Engineer's estimates. An inquiry having been held by Colonel W. Coke, C.E., Local Government Board inspector, leave was granted for the Council to raise a loan of £21,000 to carry out the work. In the meantime a temporary plant was installed to supply electricity to a large estate which was in urgent need of lighting; this has now been superseded by the permanent plant.

Works.

The electrical works have been put down close by the Sewerage Works, and are connected by a flue with the chimney shaft, which is common to both undertakings. The contract for the whole of the plant in the station was assigned to the Brush Electrical Engineering Company,

Limited, who also supplied and fixed the transformers in their latest type of street transformer box.

The boilers are of the Babcock & Wilcox type, each capable of evaporating 6,000 lbs. of water per hour; two boilers are at present installed, but space is provided for two economiser. The latter consists of 96 tubes, 9 feet long × 4 inches diameter, and is provided with a by-pass, so that it can be shut off when necessary for inspection and repairs. The scrapers are to be driven by a single-phase alternate current motor of the Kolben type.



Electric Light and Traction Engines.—Blackburn Traction Plant. (See page 980.)

more to be put down when the load becomes sufficiently great to render extension necessary. The feed water is derived from a well recently sunk for that purpose, whence it is pumped into a large storage tank of 1,000 gallons capacity, which can also be filled from the town mains.

The steam ring main is situated within the boiler house but close to the wall of the engine room, so that steam can be cut off from any engine without having to approach the latter. Each boiler is connected with the ring main through a Hopkinson automatic non-return valve. The whole of the

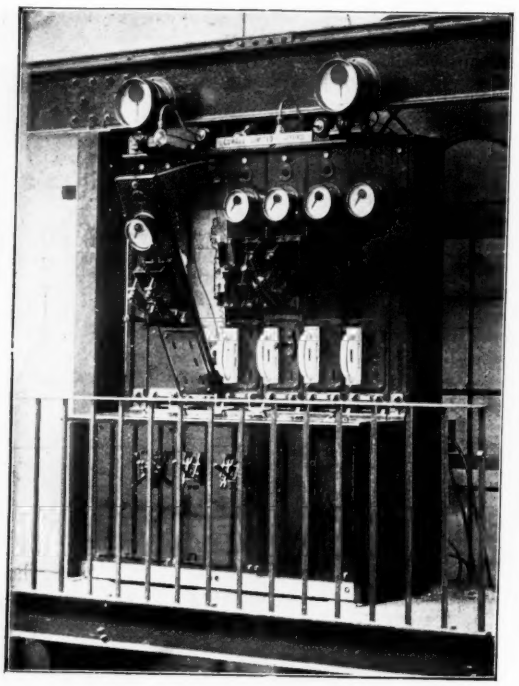
Niagara Suspension Bridge. (See page 982.)

The lift pump, as well as the feed pumps, is of the Smith-Vaile type, supplied by Messrs. Blake & Knowles Steam Pump, Limited. The feed pumps are in duplicate, with duplicate feed pipes, and are arranged so as to supply the boilers either direct from the tank or through the Green's

steam pipes, valves, and flanges are lagged with magnesia sectional covering.

The generating plant consists at present of two 150-kw. sets and one 30-kw. day load set; space is provided for a third 150-kw. set, and the station is so arranged that

further extensions can easily be carried out by removing the temporary gable wall of the engine and boiler house.



WATFORD: SWITCHBOARD.

Each generating set consists of a Raworth "Universal" engine, direct coupled to a Mordey inductor alternator, with exciter carried on the same shaft. It is interesting to note that while the Brush Company have made Universal" engines to the extent of 20,000 H.P., and a large number of inductor alternators, this is the first instance in which the two have been combined. The general arrangement of the plant will be well seen from our photograph, which shows the small set on the left hand. It will be noticed that a heavy fly-wheel is provided in each case, in addition to the massive rotors of the alternators.

Each of the larger engines develops 250 I.H.P. at 300 revolutions per minute; the cylinders are tandem, and single acting, the high pressure piston being active upwards and the low pressure piston downwards. The valves are of the Corliss type, and automatic expansion is obtained by means of a shaft governor. Indicator cocks are provided for both cylinders and for the receiver, and are so arranged as to be available for warming up the low pressure cylinder before starting. Each engine is provided with a separator on the steam pipe.

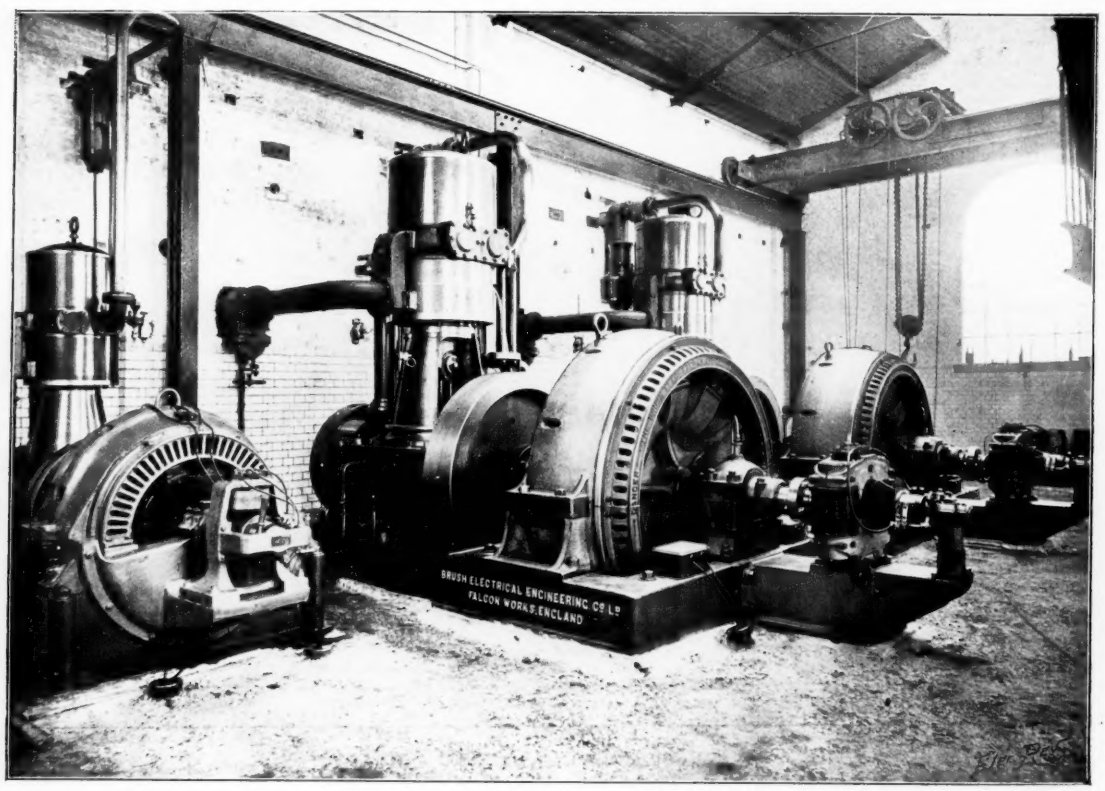
Forced lubrication is employed in the engines, oil at a pressure of 15 lbs. per square inch being pumped through the slides and crosshead, and through the connecting rod into both halves of the big end. The main bearings were perfectly cold after six hours' run at full load, in spite of the great weight of the fly-wheel and rotor.

The large alternators are designed for a pressure of 2,200 volts at a frequency of 50 periods per second, and are of the single inductor type; the rotor consists of a steel casting with laminated iron pole tips, and, of course, both armature and field coils are stationary.

The power required for the excitation of the larger machines is less than 1 per cent. of the output at full load, and has, in fact, in one case been reduced to 0·6 per cent. by the use of a smaller air-gap. The variation in the exciting current is very small over wide ranges of load.

The day-load set is of the same type, but has a double set of inductors, and runs at 375 revolutions per minute. No difficulty whatever is found in running this plant in parallel with one of the large sets, and the cross current between the two machines is trifling.

The guaranteed over-all efficiency of the 150 kw. sets was 82 per cent., with a steam consumption of 35 lbs. per kw.-hour; the corresponding figures for the 30 kw. set were 77·5 per cent., and 40 lbs. per kw.-hour. The results of the six hours' test at full load of the large combination were perfectly satisfactory, the temperature rise



WATFORD: GENERAL VIEW.

in the armature and field coils being less than 45° F. During the test one of the machines was accidentally short-circuited, without injury, and the small set has been run at 100 per cent. over load for some time without excessive heating.

A 10-ton travelling crane, operated by hand from the floor, is provided, manufactured by Messrs. Taylor & Hubbard, of Leicester.

Switchboard.

The switchboard, which we illustrate, is of the "Cowan-Still" new type, made by Messrs. Cowans, Limited, of Salford. The special features of this type of board are compactness and accessibility. The board is divided into panels, each complete in itself, of enamelled slate; there is no passage at the back of the board, but each panel can be swung forward on its lower edge, as shown in our illustration, so that its back connections are accessible. It is impossible to do this unless the fittings are "dead," so that they are perfectly free from danger to the person. The bus bars are mounted on porcelain insulators behind the board, and all high pressure parts are absolutely protected, so that accidental contact with them is impossible. The exciting circuit regulators are mounted on a horizontal desk running along the front of the board, which also carries the exciting circuit ammeters.

The only materials employed in the construction of the board are metal, slate and porcelain, so that it is fireproof. The instruments are made by Messrs. Nalder Bros. and Thompson, the voltmeters being of the Ayrton-Mather electrostatic type.

Similar boards have, we understand, been installed at Eccles, Wimbledon, &c., and a board with 37 panels for a 7,000-H.P. station in Russia.

Mains.

The high pressure feeders, about 5½ miles in length, are of the concentric type with the outer earthed, and work at 2,000 volts pressure.

There are over 25 miles of low pressure mains for the public lighting, of which 19 miles are of the twin type and 6¼ miles concentric. The low pressure private lighting cables are of the concentric type, about five miles in length, and form a network with disconnecting joint boxes.

The whole of the cables were manufactured and laid by Messrs. W. T. Henley's Telegraph Works Company, Limited, and are insulated with impregnated paper, lead sheathed, served with jute, armoured with two layers of steel tape, and finally protected with tarred jute and compound. The cables were laid direct in the ground, but in some parts of the town a pipe line has been laid to facilitate future extensions.

There are 10 street transformer boxes for the private lighting, transforming from 2,000 to 200 volts, and six for the public lighting, transforming from 2,000 to 400 volts—the distribution in each case being on the two-wire system. Each box contains a double-pole switch and fuse on both high and low pressure sides; the switches are both operated from the street level by a key, after removing a small plug in the outer cover.

Each box has provision for two high pressure and four low pressure feeders, and is adapted for any size of transformer from 6 kw. to 30 kw. without alteration, the only difference between these transformers being in the depth measurement.

Public Lighting.

The number of public lamps now being connected is 800; the Market Place and railway station approach are lighted with four Crompton arc lamps, supplied and fixed by the Watford Engineering Works Company; the whole of the rest of the public lighting is to be done with incandescents. The lamps, of 8 and 16-C.P. for the most part, are arranged two in series in each lantern across the 400-volt mains; the existing lamp-posts have been in nearly all cases adapted to the new illuminant, by the Reason Manufacturing Company, but new posts are being erected in the centre of the town.

The public lighting low pressure mains are entirely separate from the private lighting network, so that the street lamps can be controlled from six switching points; four circuits usually radiate from each of these, but are controlled by one switch. The work on the public lighting is rapidly approaching completion, and the lamps will all be available before the winter months arrive.

The chairman of the Council, Mr. A. E. Pridmore, J.P., who is also the chairman of the Electric Lighting Committee, took a prominent part in starting the scheme, and has spared no effort to further the progress of the undertaking; the surveyor to the Council, Mr. D. Waterhouse, has also rendered invaluable assistance. The work has been carried out by Mr. P. J. Pringle, assisted by Mr. P. A. Yapp, for the Brush Company, under the superintending engineer, Mr. R. A. Dawbarn; the cables were laid under the direction of Mr. W. Bolton, for the Henley Company. Mr. A. J. C. Waterland is the resident engineer, assisted by Mr. A. Mitchell-Withers.

To these gentlemen, and to Mr. W. C. C. Hawtayne, Engineer to the Council, we tender our thanks for courteously affording us every facility for obtaining information, and rendering us all the assistance in their power, in preparing this description of the undertaking.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page 979.*)

Dundee.—In connection with the taking over of the tramways by the Corporation, the Town Council is at present considering the question of traction, and also of new lines. Mr. E. Manville was recently consulted, and he has now forwarded a report to the authorities, in which he suggests that, instead of constructing a cable tramway direct from Union Street to the neighbourhood of Downfield, an electric tramway should be laid down, and that, having regard to the severe gradient on the direct route to Downfield, the line should deviate considerably by passing up the Infirmary Brae, and joining the existing tramway lines at Main Street. He points out that the Corporation would have to spend £50,000 if they decided to construct the cable tramway line which had recently been outlined, while the expenditure on the overhead system would be restricted to £40,273. He expresses the opinion that the electric system in the case of Dundee would be more efficient and satisfactory in connection with the route proposed. Dealing next with the question of having a conduit system adopted for the centre of Dundee, he states that there would be no practical difficulty in the way of a combination of conduits and overhead conductors, if the conduits were efficiently laid and kept free from water. The additional cost for lines that had to be reconstructed, at any rate would be £3,000 per mile of single track. He thinks however that, the overhead system having proved so satisfactory elsewhere, there is no need to make a departure in the direction referred to in Dundee. He therefore recommends that the overhead system should be adopted all over the city.

Gateshead.—The Council has declined to consent to a proposal of the Gateshead and District Tramways Company to construct certain tramways under the Light Railways Act.

Glasgow.—The Tramways Sub-Committee last week received a deputation from the boiler makers who, as we recently stated, said that the trolley wires, as now erected, prevented the carriage of their larger size boilers through the public streets. The sub-committee informed a deputation that if the various firms who are interested would sketch out the route from their works to the quay, arrangements would be made for disconnecting the wires when necessary, so that the boilers might pass along.

Hull.—At a meeting of the Corporation Finance Committee, Alderman Jarman (chairman) stated that they would shortly have the electric tram system in operation, and it would be necessary to have an increase of staff on that account. It was resolved that the chairman, vice-chairman, and the chairman of the Tramway Sub-Committee meet and consider the question of the staff, and that the treasurer and accountant be instructed to visit other cities and towns where a similar electric system was in operation, to ascertain the most perfect system of keeping the accounts.

Lancashire.—A conference of representatives of Radcliffe, Whitefield, and Little Lever District Councils has been held to consider the provision of electricity for lighting the three townships, and for traction purposes. The conference was attended by representatives of a London syndicate, who propose to lay an electrical tramway connecting Whitefield, Radcliffe, Little Lever, Farnworth, and Worsley with the Manchester Ship Canal at Barton Bridge. It was decided that the Radcliffe Council should prepare a rough scheme for the supply of electricity for lighting and traction purposes for their own locality, Whitefield and Little Lever, and that the London syndicate should provide further details of their proposal.

Leeds.—At a recent Council meeting Mr. Smithson submitted particulars—already published in the Electrical Review—with regard to the profits of the tramways undertaking for the past year. The surplus, after deducting sinking fund charges, was £12,030. Of this amount £4,000 was reserved for renewal of electrical equipment, and the balance—£8,030—had been paid into the city fund. Mr. Smithson remarked that the result of the year's working was an encouragement to the committee to press on with the extensions already authorised, and when the present contract was well advanced

to submit to the Council comprehensive schemes for the complete electrical equipment of all the remaining routes.

Last week the Tramways Committee sifted the 51 applications for the position of traffic manager in the tramways department, and reduced the list to half a dozen.

Lincoln.—The Electricity Works Committee is of opinion that it is desirable to construct tramways in the city operated by electricity. The report of Mr. C. S. Vesey Brown has been adopted, and the Council is recommended to take all the necessary steps for the purpose of constructing the tramways on all the three routes referred to in the report. The Mayor is requested to call a meeting of the Council in Committee for the purpose of considering the report.

London.—A daily paper says that the Duke of York is to be invited to open the West London electric tramway system of the London United Tramway Company. It is anticipated that the main section will be completed in a few weeks.

Manchester.—At last week's Council meeting it was resolved to accept the tender of the Leeds Steelworks Company for the supply of 5,000 tons of steel tramway rails, at a cost of £100,625. Mr. Linsley and the Tramways Committee were very strongly advised to make the purchase now, in view of the chance of prices going up.

Mr. Batty put a series of questions to the chairman of the Tramways Committee in regard to electric traction. He pointed out that in New York and Washington the conduit system was in use, and that in the best American opinion the trolley system was regarded as obsolete except for suburban lines. Mr. Batty suggested that a deputation should be sent to New York and Washington to make inquiries. Mr. Boyle said the committee would carefully consider the points put before them by Mr. Batty, and would probably be in a position to submit something to the next meeting.

On Friday last the Examiners of Standing Orders in the House of Commons certified that the Standing Orders had been complied with by the Shelford, Withington, and Moss Side Urban District Councils' Tramways Bills. These measures provide for powers being afforded to the District Councils named to run their own tramways in connection with those of the Manchester Corporation or otherwise. The Bills will therefore go for second reading in the House of Commons.

Newcastle (Staffs.).—The British Electric Traction Company has commenced operations in this borough upon its light railway scheme.

Oldham.—A Committee has been informed by the Board of Trade Tramways Department that the time for working the Oldham steam trams has been extended until December 27th.

Portsmouth.—At a meeting of the Town Council on Tuesday the Tramways Committee presented the following report:—

> Your Committee have had under their consideration the necessary arrangements for re-constructing the tramways when taken over, and providing electrical equipment, and, after carefully considering the matter, they are of opinion that an engineer, who will be an expert on such matters, be engaged at an inclusive fee to cover the cost of preparing plans and specifications, and generally advising on and supervising the carrying out of the work; the Corporation also engaging someone to superintend the work under the advice of the expert, and if found capable to be appointed as general manager, and your Committee recommend that they be authorised to make these appointments.

Redditch.—The District Council has received from the Light Railway Commissioners a communication to the effect that the Redditch Light Railway has been authorised, and the order submitted to the Board of Trade for confirmation. The Council wants the route to be paved with macadam instead of granite setts.

Ryde-Seaview.—There is a scheme on foot for constructing a light electric railway and marine drive between these two places. There is considerable opposition from residents.

St. Helens.—It is proposed to have a trial of the municipal electric trams in about a week or 10 days.

Sale.—At the monthly meeting of the Urban District Council on Tuesday evening a letter was read from the Local Government Board, extending the time for taking up the provisional order for the lighting of the township by electricity to the end of this year.

South Staffordshire Tramways Bill.—On Thursday and Friday last week a Select Committee of the House of Lords, presided over by the Duke of Northumberland, considered the South Staffordshire Tramways Bill promoted by the British Electric Traction Company. The petitioners against the Bill were the Handsworth Urban District Council, the Darlaston District Council, West Bromwich Council and Walsall and Wednesbury local authorities. Mr. Moon, for the promoters, stated that an agreement had been entered into with the Urban Council of Dudley, and the promoters were quite willing to consider the question of entering into similar agreements with the other local authorities who were opposing the Bill.—Mr. Coward, on behalf of the Handsworth Urban District Council, objected on the ground that the agreement with Dudley was not absolutely binding and final, because it depended on arbitration, and similar agreements would lead to no end of arbitration.—Mr. Knox, who appeared for Walsall and Wednesbury, said his opposition was against the principle of the proposal to extend the lease of the company.—Mr. Addison, solicitor, of Brierley Hill, said there was a desire for the tramways to be under one control throughout the district. As to the suggestions that the local authorities should acquire the tramways, from his knowledge of the district and the local authorities, he thought it was improbable that they would ever unite on such a question. Such an agreement he knew had long been talked about, but no scheme had been formulated. After a large number of witnesses had been heard in support of the Bill, the chairman said the committee were of opinion that so much of the Bill as deprived the local authorities of any powers which they at present enjoyed in their districts was not proved. The promoters agreed to take the Bill back and alter it, and bring up an amended Bill for the consideration of the committee.

The Southport and Lytham Tramways.—On Tuesday afternoon a Committee of the House of Lords commenced the consideration of a Bill promoted by a local syndicate for power to construct "tramroads, tramways, and a bridge" between Southport and Lytham. The Bill, which was opposed by the Preston Corporation, contained proposals of a novel nature in connection with the proposed crossing of the Ribble estuary.—Mr. Balfour Browne, Q.C., in opening the case of the promoters, referred to the attractions of the several watering places interested in the Bill—Southport, Lytham, St. Anne's, Blackpool, and Fleetwood—and gave statistics as to the enormous number of visitors resorting to them, and especially he called attention to the fact that there is a tramway from Fleetwood to Blackpool, and another from Blackpool to St. Anne's and Lytham. The distance between these places geographically, he said, was not great, and they had behind them the rich agricultural district of the Fylde and the popular towns of Lancashire and Yorkshire. Many people would wish to go from Southport to Blackpool, but the railway journey was very circuitous, the shortest, which involved a break not only of carriages, but of stations, being 28 miles. The fares were correspondingly high. In summer there was a service by a steamer across the estuary, but even this occupied a long time, and was liable to be interrupted by bad weather. There was, in fact, a great demand for better means of communication between these places, and the plan he was about to describe, which would make the distance between Southport and Lytham six miles and three furlongs, met with a large amount of local support. The Corporation of Southport and public opinion in that town were entirely with them, and though the opposition of Preston went to the merits of the scheme, he thought that of Lytham might be met by clauses. It was proposed to start from Southport with an electric tramway of the ordinary description about three miles long, and then to proceed for about two and a half miles across the estuary to the southern training wall of the river Ribble. The latter section of the tramroad would be similar in construction to the line between Brighton and Rottingdean, the rails being flush with the sands, and therefore incapable of causing accretion in the estuary of the river. At the termination of the second section and over the training walls of the Ribble estuary was to be erected a "conveyer" bridge for the purpose of carrying passengers and goods, by means of a platform suspended from the bridge by steel ropes. But there came the difficulty, because large sums had been expended by the Corporation of Preston in trying to make Preston a port, though he was sorry to say the docks there were still nearly empty. The Corporation maintained trained channels through the estuary near the Lytham side. It would never do for the promoters of this Bill to prevent the Ribble being used as a means of getting to the docks, and therefore they proposed this bridge, which would convey the cars without in any way interfering with navigation. It would be 980 feet from tower to tower. A similar contrivance was in successful operation near Bilbao, and being open to the Atlantic was exposed to a much greater force of wind than would be the case on the Ribble, while a bridge of the same character was in construction over the Seine at Rouen. Having by means of a model exhibited the mechanism and working of the bridge, Mr. Browne went on to say that the cars would be suspended 8 feet above the wave level, and could be worked irrespective of tide. The bridge would be 980 feet from tower to tower and 103 feet high, so that every steamer would be able to pass under, and also the highest masted sailing vessel by striking its top-gallant mast. It was stated by the opponents of the Bill that ships 150 feet and 200 feet high would be unable to pass, but the promotors said they did not know of these ships. Moreover, under the regulations of the Preston Corporation vessels must pass this spot an hour and a quarter before high water, which would give them an additional 4 feet and 6 inches when they passed under the bridge. If, however, the Corporation could convince the Committee that the height of the bridge was inadequate to accommodate vessels they were willing to raise the structure. The scheme was promoted by local gentlemen, and there was not the least doubt about the capital being raised. The tramroad was estimated to cost £203,862, and the conveyer bridge £36,776. Mr. Browne next referred to the petition of the Preston Corporation, which called attention to the fact that the Ribble flowed and ebbed through an estuary several miles in width, and consisted of shifting sands. An influential commission in a report to the Board of Trade had drawn attention to the injury that had accrued by works of reclamation in the estuary, and had laid great stress on the necessity of preventing further accretion in order that the tidal capacity of the estuary should not be diminished. The Corporation said that, apart from the injury to the estuary and to the channel, the works, especially the proposed bridge, would seriously affect the navigation to the docks. Many of the ships were sailing ships, with masts much higher than the permanent girder of the proposed bridge. The petitioners, in describing the bridge, said:—"A bridge is to be constructed over the channel, having a permanent girder about 103 feet above high water mark, from which is to be lowered a suspended traversing cradle to transport passengers across the channel." The Committee adjourned.

Thames Valley.—The Light Railway Commissioners sat on Monday at the Town Hall, Twickenham, to inquire into the merits of the order deposited by the London United Tramways Company, Limited, for the construction of a series of light railways in the Thames Valley. Mr. Cripps, Q.C., M.P., and Mr. Lewis Coward appeared in support of the order, which was principally opposed by the Middlesex County Council, who were represented by Mr. W. S. Robson, Q.C., M.P., and Mr. Earle, and the London and South-Western Railway Company, who were represented by the Hon. Alfred Lyttleton, M.P. The scheme, as put before the Commissioners, comprised, says the *Times*, nine sections of light railways of an aggregate length of 13 miles 6 furlongs 4 chains. The proposed railways were laid out so as to form an extension of the London United Tramways system from Hounslow to Baber Bridge in one direction, and from near Brentford to Twickenham, Hampton, Hampton Wick, Kingston, and Teddington in another direction, with a branch to Richmond. The proposed railways were supported by all the local authorities interested, but after hearing evidence, the Commissioners decided that as the lines were laid out to compete with the London and South-Western Railway, it was a scheme which ought to be considered by Parliament. So far as the Commissioners are concerned the order will not, therefore, be sanctioned.

Wolverhampton Tramways Bill.—A Select Committee of the House of Lords, presided over by the Duke of Northumberland, on Friday last considered the Wolverhampton Corporation Tramways Bill, the object of which is to authorise the making, improving, and altering of tramways inside the borough boundaries of Wolverhampton, to acquire, alter, and improve tramways outside the boundaries, and to work the whole by electrical power. Mr. Pember, Q.C., and Mr. Rann appeared for the promoters, Mr. Balfour Browne, Q.C., for the British Electric Traction Company, and Mr. Littler, Q.C., for the London and North-Western Railway Company. —Mr. Pember stated that it was desired to improve the tramway service. The existing tramways simply required alterations to fit them to be worked by electricity. Some of the existing tramways extended a little outside the borough, especially in the direction of Willenhall and Bilston, and these it was proposed to improve. The time fixed by the Act of 1870 for the purchase of the tramway company's undertaking had expired, and the notice to purchase had been duly given by the Corporation.—The Committee, after hearing evidence and counsel, decided to pass the preamble of the Bill, but postponed the consideration of the clauses to a later date.

Wrexham.—The Town Council have, it is announced, affixed their seal to an agreement with the Drake & Gorham Electric Power and Traction Company, Limited, enabling them, after the expiration of one of three dates specified from the confirmation of the District Tramways Provisional Order, to acquire the undertaking.

TELEGRAPH AND TELEPHONE NOTES.

German Telegraphs to the East.—In the House of Commons last week Mr. Brodrick said he could not make any statement as to the intentions of the Government in view of the concessions given to German capitalists for the construction of a railway through Asia Minor to Bagdad, but the Government were fully alive to the necessity of maintaining British interests in the Persian Gulf. We understand that the British Minister of Bucharest recently presented a note to the Roumanian Government applying for authority for the Eastern Telegraph Company to make cable connection with the Constantinople-Constanza line. This application, however, received an unfavourable reply from the Roumanian Cabinet, on the grounds that similar concessions had been previously granted to a German company.

Interruption of Cables to the Cape.—We learn that the Mozambique-Delagoa Bay cable, which was laid 20 years ago, and which has not yet been duplicated, was repaired on the 9th inst. after having been interrupted a period of about 14 days. This interruption occurring, as it did, at the time of the conference between Sir Alfred Milner and President Kruger, caused very considerable inconvenience, and placed Mr. Chamberlain in rather a false position in the House of Commons, as the version of the Pretoria Executive was published in London before Mr. Chamberlain had Sir Alfred Milner's report in his hands. The interruption, unfortunate as it is, to a certain extent plays into the hands of the Eastern cable group, as it shows that the present means of communication to the Cape cannot be relied on, but instead of furnishing them with grounds for claiming an additional subsidy of £20,000 a year from the Government for the extension of the cable *viâ* St. Helena and Ascension, it rather points to the necessity, which the company should recognise, of duplicating their cables between Lourenço Marques-Mozambique and Aden-Zanzibar, both of which were laid 20 years ago, and have frequently been interrupted, thus pointing to the urgent necessity of duplication.

The Pacific Cable.—The *Times* publishes the following from a correspondent:—"The urgent representations which the High Commissioner for Canada and the Agents-General for Australasia have addressed to the British Government on the subject of the Pacific cable have not been without effect. The Imperial Government have decided to modify the form and extent of the assistance which they are prepared to give to the Pacific cable scheme. They proposed originally to contribute for 20 years an annual subsidy not exceeding £20,000 in any year. This subsidy, however, was to be calculated on a basis which would limit the responsibility of the Treasury to $\frac{2}{3}$ths of the amount by which the net receipts of the cable fall short of the amount of the expenses. This proposal not only gave no satisfaction to the Colonies, but caused indeed a certain dismay. Urgent representations were addressed both to the Colonial Office and to the Treasury to the effect that a modification of the position taken up in the offer of April 28th was desirable. Apparently these have had weight, for the Colonial Office, while defending the original offer as generous and advantageous to the Colonies, has acknowledged the force of the arguments based upon the appeal to higher grounds than mere commercial expediency. In order to meet the wishes of the Colonies the Government have intimated a willingness to reconsider the cable scheme on the basis of utilising the credit of the United Kingdom in the provision of the capital necessary. The Cable Committee recommended that the cable should be owned and worked by the Governments interested, and that is the position the Colonies have throughout contended for. It is not quite clear if the amended offer of the Imperial Government goes as far as that. If it does, the satisfaction in the Colonies will be the more complete."

We learn that Sir Andrew Clarke, the Agent-General in London, has been appointed to represent Victoria at the conference with Mr. Chamberlain and Sir Michael Hicks-Beach with reference to the Pacific cable. He will have no power to commit the colony without first consulting Sir G. Turner, the Premier.

In the House of Commons on Tuesday night Mr. Hogan inquired from Mr. Chamberlain whether the proposals of Her Majesty's Government in reference to the construction of the Pacific cable have been subjected to revision, and, if so, whether he can give particulars of the amended offer of co-operation with the Canadian and Australasian Governments.—In reply, Mr. Chamberlain said: "The matter is still under discussion between Her Majesty's Government and the Colonial Governments concerned, and I am not yet in a position to make a statement."

Commenting on the statement that the Imperial Government had intimated a willingness to reconsider the Pacific cable scheme on the basis of utilising the credit of the United Kingdom in the provision of the capital necessary, the Canadian newspapers declare that such action would not be in harmony with the spirit of the Cable Committee's resolution, and express the hope that the British Government will assume its share of the maintenance and construction of a State-owned cable on the basis agreed to by Canada and Australia.

A Reuter's telegram from Sydney says that Sir Julian Salomons, Q.C., the Agent-General of New South Wales in London, has been appointed by his Government to represent that Colony at the forthcoming Pacific Cable Conference. It is understood that each of the Colonial Governments interested in the question will be invited to appoint delegates to meet the Chancellor of the Exchequer and the Secretary of State for the Colonies in this connection. The precise object of the Conference is to discuss questions relating to the mode of raising the necessary capital and to the construction and control of the projected Pacific cable.

Scottish Islands.—Last week the cable steamer *Monarch* completed the work of establishing telegraphic communication between the small islands Canna, Rum, and Eigg, and the mainland of Scotland. A cable was first laid between the Point of Sleat, in Skye, to the Island of Eigg, and continued from there to Rum. A land wire was run across Rum to connect with the cable from Rum to Canna. The previously existing cable service across the Sound of Sleat completes the connection.

The South African Cable.—In the House of Commons on Tuesday Mr. Ellis Griffith (Anglesey) asked the Secretary of State for the Colonies whether he could state the cause of the delay in the transmission of Sir Alfred Milner's memorandum on the subject of the Bloemfontein conference; and, if so, whether there was reason to believe that there had been intentional interference with the prompt and regular despatch of such memorandum. Could he state where the delay in the transmission of the message occurred; and whether he could explain the circumstances under which the representative of the Transvaal Government in Europe received information as to the proceedings at and the result of the Bloemfontein conference before such information reached the Colonial Office. Mr. Chamberlain replied: Sir A. Milner's memorandum was at first communicated to Reuter's Agency and was transmitted as a Press message and not as a Government message. The delay in transmission was due to the partial interruption of the cable for repairs. I have no reason to believe that there was any intentional interference with its despatch. The message sent from the Transvaal was sent as a Government message and so obtained priority. On learning that Reuter's message was delayed, I instructed Sir A. Milner to have his memorandum sent as a Government message.

Telegraph Rates to India.—We understand that a despatch is on its way from Simla to the Secretary of State for India suggesting a method by which a reduction of not less than 50 per cent. should be effected on the present telegraph tariff between India and Europe. In reference to this subject the *Investor's Review*, more sanguine than usual, says "the Eastern Telegraph Company is good, and profits are not likely to be diminished to any great extent, even if the agitation for a reduction in the Indian rate should be successful." Assuming this to be correct, there is all the more reason why the rates should be reduced at once, especially as we have it in the evidence given before the Pacific Cable Committee by Mr. Finch, the director-in-chief of the Indo-European Telegraph Department, that only about 15 hours out of the 24 are employed for paid traffic passing over the lines of which he has control. The balance of time at least ought to be made available for traffic sent at a reduced or deferred rate, as in the case with the landline traffic throughout India.

The Telegraph Wire Export Trade.—A very quiet state of affairs prevailed in the export trade of this country in telegraphic wire and apparatus connected therewith during May, the value of the shipments during the month having only amounted to £31,377, which compares with £49,719 in the preceding month, and £41,944 in May, 1898. Owing to the activity which prevailed in this branch of trade during the early months of the year, the returns for the five months ending with May last still show a satisfactory increase over the corresponding periods of the past two years, the respective figures being:—

First five months of	1899	£473,856
" "	1898	355,615
" "	1897	382,386

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	June 11th, 1898 ...	...
Bonny-Cameroun	May 29th, 1899 ...	...
Lourenco Marques-Mozambique	May 26th, 1899 ...	June 9th, 1899.
Para-Maranham	April 10th, 1899 ...	...
Assab-Massaouah	May 23rd, 1899 ...	June 12th, 1899.
Landlines.		
Communication between Salonique and Monastir.	March 16th, 1899 ...	...
Communication with Jérémié and Port de Paix (Hayti)	May 20th, 1899 ...	June 10th, 1899.
Communication with Swakopmund	May 18th, 1899 ...	June 12th, 1899.
Line between Antofagasta and Cochabambu (Bolivia)	May 9th, 1899 ...	June 7th, 1899.
Saigon-Bangkok ...	June 10th, 1899 ...	June 11th, 1899.

The Telephone Question.—At a meeting of members interested in telephone development held in one of the Committee rooms of the House of Commons the other day, Mr. Faithfull Begg presiding, it was resolved, on the motion of Mr. Charles M'Arthur, seconded by Mr. Kimber:—

That the proposed municipalisation of telephones is undesirable, both from a municipal and a public point of view, and that this conference would prefer that the entire telephone system of the country should be under direct Government control as the best means of satisfactorily providing for the harmonious development and conduct of telephonic communication in the future. It is, therefore, hoped that the Government will see fit to reconsider the Telegraphs (Telephonic Communication, &c.) Bill, and will make such arrangements as will enable the whole system of telephones to be acquired and worked by the State.

Amongst those present at the meeting were representatives of the Manchester and Liverpool Stock Exchanges and of the Chambers of Commerce of Liverpool, Manchester, Bristol, Nottingham, and other towns. On the other hand, says the *Times*, a deputation from the Corporation of Glasgow waited upon Mr. Hanbury to urge the necessity of the Government's pressing forward without undue delay the measure referred to in the preceding paragraph. Mr. Hanbury, in reply, gave an assurance that the Government would persevere with the Bill in order that it might be placed upon the Statute Book before the end of the present Session.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barnsley.—Tenders are wanted for an electric lighting plant for the shops, screens, sidings, &c., at Wooley Collieries, near Barnsley. For particulars apply at the Colliery Office.

Barrow-in-Furness.—June 28th. The Corporation wants tenders for an additional engine and generator, with extensions to the switchboard and connections. Specifications, &c, from Messrs. Kincaid, Waller and Manville, on payment of £3 3s.

Blackpool.—June 20th. The Corporation wants tenders for 6,000 tons of slack, 3,250 gallons of oil, and 138,000 carbons. See "Official Notices" June 2nd.

Canary Islands.—July 16th. Tenders are being invited until July 16th by the Spanish Post and Telegraph Authorities in Madrid for the concession for the establishment and working of a telephone system between Haria and Arrecife with three intermediate stations on the island of Lanzaroto, Canaries. Tenders to be sent to La Direccion General de Correos y Telegrafos, 10, Callede Carretas, Madrid, whence particulars may be obtained.

Canterbury. — June 20th. The Corporation wants tenders for the excavation of certain trenches (2½ to 3 miles), for electricity mains. Particulars from the Town Clerk.

Dudley.—June 17th. The Electric Lighting Committee wants tenders for water-tube boilers, economiser, steam dynamos, balancers, switchboard, cables and street work, arc lamps, and travelling crane. See "Official Notices" May 19th.

France.—June 22nd. Tenders are being invited until the 22nd inst. by the French Post and Telegraph authorities in Paris for the supply of 510 tons of galvanised iron wire, 3 and 4 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Germany.—July 4th. The State Small Arms Works authorities at Spandau are inviting tenders until July 4th for the supply of 1,200 incandescent lamps, and 13,000 sets of arc lamp carbons. Particulars may be obtained from, and tenders are to be sent to, Der Direktion der Gewehrfabrik, Spandau, near Berlin.

Hull.—June 27th. The Kingston-upon-Hull School Board wants tenders for electric light wiring and fittings at the Central Higher Grade School (360 lights). See "Official Notices" this week.

Pembroke. — July 14th. The Electric Lighting Committee wants tenders for a jet condenser with air pump and cooling apparatus. See "Official Notices" this week.

Rathmines and Rathgar.—July 14th. The Electric Lighting Committee wants tenders for arc lighting equipment (108 series parallel lamps, posts and switch-gear, &c.), steam and other pipes, jet condenser and cooling apparatus. See "Official Notices" this week.

Southampton.—June 26th. The Corporation is inviting tenders for the extension of the generating station at the Back-of-the-Walls, comprising accumulator and switch rooms.

Spain.—June 25th. Tenders are being invited until June 25th by the municipal authorities of Alcala la Real (province of Jaen), for the concession for the electric lighting of the town during a period of three years. Particulars may be obtained from, and tenders to be sent to, El Secretario del Ayuntamiento de Alcala la Real (Jaen).

West Africa.—July 10th. The Compagnie de Mozambique, of 45, Rue do Alecrim, Lisbon, is inviting tenders until July 10th for the concession for the establishment and working of a central electric power station at Beira for lighting and power purposes during a period of 25 years. Particulars from, and tenders to, above.

CLOSED.

Blackpool.—The Corporation has given the contract for the construction of 10 bogie tramway cars to the Midland Railway Carriage and Waggon Company, Limited, of Shrewsbury. The Lancaster Carriage and Waggon Company, Limited, Ashbury's Railway Carriage and Iron Company, Limited, and Messrs. Hurst, Nelson & Co., Limited, also tendered.

Hampstead.—For the proposed extensions at the central station the Vestry has accepted the tender of Messrs. Siemens Bros. and Co., Limited, for the supply of two Siemens-Belliss sets at a cost of £10,345, and, having regard to the length of time required by firms to carry out contracts, an order has also been placed with Messrs. S. Z. de Ferranti, Limited, for two Ferranti-Belliss sets at a cost of £11,400.

London. — The London County Council on Tuesday accepted the following tenders for the supply of engineers' goods and electrical stores during the ensuing year: — John Dickson, M. Wilson & Co., Pryke & Palmer, Buck & Hickman, and J. Gibb and Co.; the Edison & Swan Company, Veritys, Limited, Turner and Hudson, the General Electric Company, and Dorman & Smith.

London.—The St. Pancras Vestry on Wednesday considered the following tenders for the supply of the trunk main to connect the two generating stations, and for the cables required for various extensions sanctioned by the Vestry:—

D. Cassirer & Co.	£13,237
W. T. Glover & Co.	12,652
British Insulated Wire Company	12,249
W. T. Henley's Telegraph Works Company	11,793
Callender's Cable and Construction Company	11,320
Siemens Bros. & Co.*	11,194
Western Electric Company (incomplete)	9,656

* The tender of Messrs. Siemens Bros. & Co. was accepted.

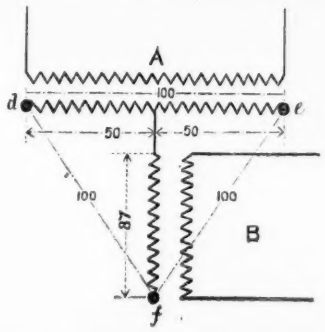
Wolverhampton.—The Town Council have accepted the tender of Mr. J. Orme Brettell, engineer, &c., of the Foregate, Worcester, amounting to £2,218 3s. 6d., for the construction and erection of the steel and iron work of new battery room floor, over the boiler house, at the Corporation Electricity Works, Commercial Road, Wolverhampton; and the Council have also approved of Messrs. Dorman, Ling & Co., of Middlesborough, as sub-contractors under clause 12 of the general conditions.

FORTHCOMING EVENTS.

Friday, June 16th, and Saturday, June 17th. Convention of the Municipal Electrical Association at Bristol.

NOTES.

Combined Two- and Three-Phase Transmission.—A somewhat curious combination of two and three-phase alternating current is being advocated for long distance transmission lines in America. The arrangement proposed is to generate current as two-phase, and before it leaves the station convert it into three-phase, and so save the 25 per cent. of copper in the line. At the receiving end current is reconverted into two-phase, and so used for both power and lighting without any



trouble. The conversion is effected very simply by means of two single-phase transformers, as shown in the accompanying figure. A and B are the two single-phase transformers of the two-phase transmission, and the points, *d*, *e* and *f*, are where the three-phase wires are connected. The numbers represent the voltage ratios of the different parts of the arrangement, which, it may be mentioned, is due to Mr. C. F. Scott, and was fully described in the ELECTRICAL REVIEW, of April 27th, 1894. We fail to see any reason why the three-phase current should not be generated at high pressure, and supplied *direct* to the line, without the use of step-up transformers—unless the line pressure is excessively high.

Freight on Electric Machinery from America.—The freight on the whole of the Central London Railway material is said to average only £4 a ton. This figure covers the collecting in America, lightering up the river Thames, loading on to London and North-Western Railway trucks at Poplar, and delivery on site at Shepherd's Bush. Presuming that the contracts had been given to British firms, situated, say, in the North of England, the carriage would probably have been 30s. a ton—that is to say, home firms ought to be able to underquote by an amount equal to about 50s. per ton weight of material. On a large contract this would run into several thousand pounds sterling, quite sufficient, other things being equal, to turn the scale in favour of a British firm's tender. Unfortunately other things are not equal—promptness of delivery, for example—and although it is the fashion to make a scapegoat of the late strike, there can be no doubt that our electrical engineering firms are much behind in organisation and capacity for undertaking new and original work.

Copper.—Reuter's Berlin representative says it is reported that in consequence of the present enormously high price of copper, the German Imperial Telegraph authorities intend to largely reduce the need for copper by using for the present telegraph lines constructed of iron wires, and for telephone lines instead of copper wire to employ aluminium or iron wire with copper sheathing.

Liquid Hydrogen at the Royal Institution.—Lecturing at the Royal Institution on the 8th inst., Prof. Dewar signalised the conclusion of the centenary celebration by exhibiting a quantity of liquid hydrogen, boiling at a temperature of about −260° C. The liquid is very costly to manufacture, extremely volatile, and of very low density. The temperature attained is the lowest on record, being practically that of inter-stellar space. Prof. Dewar liquefied hydrogen for the first time over a year ago, in the laboratories of the Royal Institution, but this is the first appearance of the liquid at a public demonstration.

Aluminium Manufacture at Niagara.—The Pittsburg Reduction Company, manufacturers of aluminium, are doubling the capacity of their lower works at Niagara Falls. This plant is located on the lands of the Niagara Falls Hydraulic Power and Manufacturing Company at the edge of the high bank, and is supplied with power from a station located at the water's edge in the gorge. The company have erected a large frame building, covered with corrugated iron, adjoining their works, and this will afford additional storage facilities, and thus allow an extension of the pot room in the original plant. During the present summer they will instal in the power house in the gorge four new 1,000 H.P. generators, which will be direct connected to two new turbines, each of 2,500 H.P. capacity. This practically means a doubling of the output capacity of the works. In this connection it may be mentioned that R. B. Mellon, of T. Mellon and Sons, bankers, Pittsburg, Pa., has been elected to succeed the late Captain Alfred E. Hunt, as president of the Pittsburg Reduction Company. Arthur V. Davis, of Pittsburg, is still general manager, and since Captain Hunt's death many additional responsibilities of the company have devolved on him.

Personal.—In a Convocation holden in the Divinity School, Oxford, on 8th inst., the degree of D.C.L., *honoris causa*, was conferred upon various foreign scientists of eminence, including Henri Becquerel, Membre de l'Institut, Professor of Physics at the Ecole Polytechnique, Paris; Henri Moissan, Membre de l'Institut, Professor of Toxicology in the Ecole Supérieure de Pharmacie, Paris, director of the Laboratory of the Ecole Pratique des Hautes Etudes en Sorbonne; and Simon Newcomb, Professor of Mathematics and Astronomy, Johns Hopkins University, Baltimore.

Mr. J. W. Boucher, A.I.E E., district superintendent of the Edison & Swan United Electric Light Company, Limited, has been elected hon. auditor of the Architectural Association of Ireland, session 1899-1900, and hon. secretary of the Masters' Electrical Contractors' Association of Dublin.

We understand that Prof. Andrew Jamieson, M.I.C.E., F.R.S.E., &c., who recently resigned the electrical engineering professorship at the Glasgow and West of Scotland Technical College, is now engaged upon consulting work in connection with mechanical and electrical engineering with a view to advising upon lighting, tram and power schemes, municipal and otherwise. His address is 16, Rosslyn Terrace, Kelvinside, Glasgow.

The Carnarvon Town Council have decided to show their appreciation of Sir W. H. Preece by offering him the freedom of the borough.

Appointments Vacant.—Physical laboratory assistants are wanted for optical and electrical work at the Northampton Institute. See "Official Notices" this week.

The Ealing District Council wants an assistant electrical engineer at £150 per annum. See "Official Notices."

City and Guilds of London Institute.—An interesting exhibition of the work of successful candidates for certificates at recent technological examinations was opened at the Imperial Institute on Friday last (June 9th) by the Duke of Devonshire, who in a preliminary address gave some interesting details of the progress of technical education during recent years. Mr. G. Matthey, F.R.S., chairman of the Examinations Committee, presided on the occasion, and a vote of thanks to his Grace was moved and seconded by Sir Fredk. Abel, chairman of the Executive Committee, and Mr. W. Bousfield, vice-chairman of the Examinations Committee.

Fire.—On Thursday night last week the *Duplex*, one of the cable steamers of the Eastern Telegraph Company, was damaged by fire in the South-West India Docks. The fire broke out in the engineer's store-room, and this, with the casing of the cable tank in the main hold, sustained serious damage.

Appointment.—Mr. J. Loftus Owen, C.E., M.I.E.E., has been appointed contract engineer to the British Electric Traction Company, Limited.

The Bristol Convention of the M.E.A.—The Lord Mayor of Bristol opened the M.E.A. Conference on Wednesday by cordially welcoming the members to the town of perennial youth, as it is called. After enumerating the places of interest in and around the town, and calling attention to its great commercial features and increasing prosperity, the speaker went on to enlarge upon the educational advantages possessed by Bristol, and briefly touched upon the electrical tram system. The population during the past 60 years has trebled itself. For the electrical developments in the town thanks were due to Mr. Faraday Proctor and Mr. George Pearson, the latter of whom the Lord Mayor eulogises most highly for his business attainments and his devotion to the interests of the city. After a few more appropriate remarks, Mr. Faraday Proctor, the M.E.A. president, returned thanks on behalf of the Association for the warm welcome which had been extended to them, and then proceeded to deliver his presidential address, which will be found in our other columns. Mr. Councillor Pearson was then called upon to read his long paper on "Municipal Trading," which, in mercy to his audience, he did by referring briefly to the various points discussed therein. One peculiar feature was a statement that certain portions of the paper, attributed to the editor of *Lightning*, were unreservedly withdrawn, the editor repudiating the assertion that he was in any way responsible for what Mr. Pearson alleged. Mr. Ferranti opened the discussion, which was carried on by the Mayor of Halifax, Mr. Todd, Bailie Maclay, Mr. Lloyd, Mr. Calvert, Mr. Richards, Mr. Dixon, Mr. Chamen, Mr. Grime, Mr. Jenkinson, Mr. Steinitz, Mr. Gibbings, and Mr. Butterworth. Then came Bailie Maclay with his paper on "Appropriation of Profits and Repayment of Loans," with which he incorporated a reply to those who criticised his paper of last year. The discussion was opened by Mr. Councillor Pearson, who was followed by Dr. Panton, Mr. Mountain, Mr. Boot, Mr. Bray, Mr. Calvert, and Mr. Potter. Bailie Maclay briefly replied, and the meeting then adjourned to the Royal Hotel to take luncheon on the invitation of Mr. Councillor Pearson, and the afternoon and evening were devoted to visiting the electricity and dust destructor works at Cheltenham, by kind invitation of the Mayor of that town, Mr. Alderman Norman. Some 80 to 90 gentlemen attended the conference, but others are expected to arrive later.

Re Nernst's Lecture.—The following comes to hand as we go to press:—"The letter of 'Observer' in your issue of the 26th ult. reduces to the following:—

Mr. Rathenau prophesies.
Mr. Jas. Swinburne is a prophet.
Mr. Rathenau's prophecy differs from that of Mr. Jas. Swinburne.

Therefore, Mr. Jas. Swinburne *is wrong again* (italics, please). Strange logic truly!—A SECOND OBSERVER."

Long Distance Transmission of Electrical Power.—Prof. Geo. Forbes writes to the *Society of Arts Journal* as follows:—

In a paper of mine, published in the number of the *Journal of the Society of Arts*, dated November 25th, 1898, some tables are given for facilitating calculations connected with the transmission of electrical energy to a distance. In Table III. the column of current densities, with an inefficiency of 1·3, is wrong, and as these tables may probably be copied, I desire to give the correct values of the current densities at the inefficiency 1·3 for the different distances and electric pressures, indicated by the reference letters A to K. These are as follows:—

A	1,064	D	266	G	152
B	532	E	215	H	133
C	355	F	177	K	89

This table will be found in the ELECTRICAL REVIEW, December 9th, 1898, p. 880.

The Civil's Conversazione.—Among the numerous exhibits at the Institution of Civil Engineers' conversazione last week were: a model of the *Turbinia* from the Hon. C. A. Parsons; Callendar's electrical recording instruments, Prof. Ewing's seismograph and Mr. W. Duddell's oscillograph for tracing alternate current wave forms, by the Cambridge Scientific Instrument Company; Holden's liquid fuel burner, as used on the G.E.R. locomotives; and a working model of a magnetic system of train signalling from Mr. W. S. Boult. Sir W. H. Preece and Miss Preece received the guests.

Electric Lighthouse.—It is stated that the chief of the hydrographic department of the Russian Ministry of Marine has decided to have erected, without delay, a lighthouse fitted with electric light at the Uspenski Monastery, near Odessa, in the Black Sea.

NEW COMPANIES REGISTERED.

Tyneside Electric Power Company, Limited (62,408).—This company was registered on June 2nd, with a capital of £100,000 in £1 shares, to carry on in the Tyneside district and elsewhere in the counties of Northumberland and Durham, and in the city and county of Newcastle-on-Tyne, the business of electricians, mechanical and electrical engineers, suppliers of electricity for the purpose of light, heat, and motive power, iron, brass, and metal founders, metal workers, colliery owners, &c. The first subscribers (each with one share) are:—Norman C. Cookson, Sandhill, Newcastle-on-Tyne, lead manufacturer and coal owner; Christopher J. Leyland, Haggenden Castle, Beal, Northumberland, engineer; John D. Milburn, Guyzance, Acklington, Northumberland, ship and colliery owner; Alan A. C. Swinton, 66, Victoria Street, Westminster, engineer; Charles A. Parsons, Holwyn Hall, Wylan, Northumberland, engineer; Herbt. C. Hawey, 57, Westgate Road, Newcastle-on-Tyne, solicitor; Saxton W. A. Noble, The Grove, Newcastle-on-Tyne, engineer; and John B. Simpson, Bradley Hall, Wylam-on-Tyne, coal owner. The number of directors is not to be less than three nor more than eight; the first are Hon. C. A. Parsons, Norman C. Cookson, Christopher J. Leyland, J. D. Milburn, J. B. Simpson, and A. A. Campbell Swinton; qualification, £250; remuneration as fixed by the company.

India Corporation, Limited (62,412).—This company was registered on June 2nd, with a capital of £100,000 in £1 shares, to seek for and secure openings for the employment of capital in India and elsewhere, and to construct and maintain tramways, railways, bridges, reservoirs, telegraphs, telephones, electric lighting and other works, &c. The first subscribers (each with one share) are:—Albert Hubbard, 15, Palace Square, Upper Norwood, S.E., choirmaster; A. H. Hossack, The Cottage, New Barnet, Herts, solicitor; J. Blavan, 35, Albert Street, Barnsbury, N, solicitor's clerk; G. R. Stott, 8, Braydon Road, Stamford Hill, London, N., engineer; G. H. Parker, Herongate, Brentwood, clerk; A. B. Moir, 45, Guildford Street, Russell Square, W.C., accountant; and A. L. Coopman, 44, Eyot Gardens, Hammersmith, W., shipping clerk. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £250; remuneration, £100 each per annum, and £150 for the chairman.

William Whiteley, Limited (62,423).—This company was registered on June 2nd, with a capital of £900,100 in £1 shares, to acquire and carry on business of a universal provider, now carried on at Westbourne Grove, W., and elsewhere, by William Whiteley, including the business of electrical and general engineers, electrical manufacturers, &c. The first subscribers (each with one share) are:—W. Whiteley, 39, Westbourne Grove, W., universal provider; S. Wheeler, 6, Eron Road, Hampstead, chartered accountant; W. Whiteley, jun., 39, Westbourne Grove, W., manager; F. E. Whiteley, Westbourne Grove, W., manager; C. Thomson, 57, Onslow Square, W., merchant; J. Keith, 39, Westbourne Grove, W., managing director; and W. J. Cole, 39, Westbourne Grove, W., secretary. The number of directors is not to be less than three nor more than seven. The first are William Whiteley (chairman), Samuel Wheeler (vice-chairman), William Whiteley, jun., Frank E. Whiteley, Courtauld Thomson, and James Keith (managing director). Remuneration of William Whiteley and Samuel Wheeler, £2,000 each per annum; others, £500 each per annum. Registered office, 39, Westbourne Grove, W.

Middleton Engineering Works, Limited (62,466).—This company was registered on June 7th, with a capital of £10,000 in £1 shares, to acquire and take over as a going concern the business carried on at Middleton, Lancs., as "Fleming, McFarlane & Co.," to enter into an agreement with John Fleming and George Hebden, and to carry on the business of electrical and mechanical engineers, machine, boiler, and tool makers, iron and brass founders, &c. The first subscribers (each with one share) are:—John Fleming, Middleton, engineer; George Hebden, 66, Spring Vale, Middleton, engineer; Peter T. William, Market Place, Middleton; Chas. W. Lancaster, 27, Corporation Street, Manchester, civil engineer; Alfred H. Bell, 26, Wellington Road, Oldham, cashier; John Hulton, 16, Clegg Street, Oldham, accountant; and Henry Clarke, Weston House, Manchester, foreman. Registered without articles of association. Registered office, Victoria Works, Middleton, Lancs.

London Electrical Fittings Company, Limited (62,468).—This company was registered on June 8th, with a capital of £3,000 in £1 shares, to adopt an agreement with A. G. Hopkins, W. B. Hopkins, M. H. Galsworthy, and S. S. Galsworthy, and to carry on the business of art metal workers, manufacturers of and dealers in electrical fittings and accessories, suppliers of electricity, &c. The first subscribers (each with one share) are:—Arthur G. Hopkins, Glun House, Surrey Street, W.C., civil engineer; Walter B. Hopkins, Glun House, Surrey Street, W.C., civil engineer; Sydney S. Galsworthy, Glun House, Surrey Street, W.C., electrical engineer; Miss Ada B. Galsworthy, 10, Craven Hill Gardens, W.; Martyn H. Galsworthy, 7, Hills Place, Oxford Circus, W., electrical engineer;

Mrs. Mary Galsworthy, 6, Welbeck Mansions, London; Mrs. Emily P. Hopkins, Rydalview, Streatham; and Mrs. Alice K. Hopkins, 57, Nevern Square, S.W. The number of directors is not to be less than two nor more than five; the first are A. G. Hopkins, Walter B. Hopkins, Montague H. Galsworthy, and Sydney S. Galsworthy (life directors); special qualification, 500 shares.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Elmore's German and Austro-Hungarian Metal Company, Limited (32,457).—This company's annual return was filed on May 15th, when 62,981 ordinary, and 22,325 preference shares were taken up out of a capital of £162,981 in 50,000 preference shares of £2 each, and 62,981 ordinary shares of £1 each. £2 has been called on the preference shares, and £1 on 37,891 ordinary, 25,000 being considered fully paid. £101,762 12s. 10d. has been received, including £1,457 12s. 10d. on 1,730 forfeited shares, and £20,674 on 10,337 cancelled shares.

Eastern Extension, Australasia and China, Telegraph Company, Limited (7,224 C.).—This company's annual return was filed on May 17th, when 250,000 shares were taken up out of a capital of £3,000,000 in £10 shares, and paid for in full.

Indo-European Telegraph Company, Limited (3,953).—This company's annual return was filed on May 21st, when 17,000 shares were taken up out of a capital of £450,000 in £25 shares. The full amount has been called, resulting in the receipt of £425,000.

Cuba Submarine Telegraph Company, Limited (4,710 C.).—This company's annual return was filed on May 16th, when the entire capital of £220,000 in 16,000 ordinary and 6,000 preference shares of £10 each was taken up and paid in full.

Folkestone Electricity Supply Company, Limited (51,825).—This company's annual return was filed on April 22nd, when the whole capital of £50,000 in £5 shares was taken up. £5 per share has been called, and £46,721 paid, leaving £3,279 unpaid.

Oriental Telephone and Electric Company, Limited (40,691).—This company's annual return was filed on May 11th, when 171,504 shares were taken up out of a capital of £200,000 in £1 shares. 171,497 are considered as paid, and £7 has been received on the others.

Guildford Electricity Company, Limited (36,725).—This company's annual return was filed on April 19th, when 2,166 ordinary and 500 founders' shares were taken up out of a capital of £20,000 in 3,900 ordinary shares of £5 each, and 500 founders' shares of £1 each. The full amount has been called, resulting in the total receipt of £11,330; £2 has been paid on forfeited shares.

Buenos Ayres and Belgrano Electric Tramways Company, Limited (55,957).—This company's annual return was filed on April 11th, when 40,000 "A" preference, 27,500 "B" preference, and 100,000 ordinary shares were taken up out of a capital of £850,000 in 40,000 "A" preference, 30,000 "B" preference, and 100,000 ordinary shares; all the ordinary and "B" preference are considered as fully paid, and £3 has been called on the "A" preference, resulting in the receipt of £120,000.

National Electric Free Wiring Company, Limited (53,364).—This company's annual return was filed on April 13th, when 118,971 shares were taken up out of a capital of £250,000 in £1 shares. 10s. has been called on 93,120, and £1 on 2,000, resulting in the receipt of £51,060. 18,851 are considered as fully paid.

Eastbourne Electric Light Company, Limited (16,422).—This company's annual return was filed on May 25th, when 2,072 shares were taken up out of a capital of £50,000 in £10 shares. £10 has been called on 1,949, and £5 on 1,123, resulting in the receipt of £25,105.

Calcutta Electric Supply Corporation, Limited (50,882).—This company's annual return was filed on June 5th, when the entire capital of £100,000 in £5 shares was taken up. £4 per share has been called, and £79,156 paid, leaving £844 unpaid.

Brazilian Submarine Telegraph Company Limited (6,886 C). This company's annual return was filed on May 31st, when 205,303 shares were taken up out of a capital of £2,500,000 in £10 shares. £10 per share has been called, and £2,053,030 paid.

Brockie-Pell Arc Lamp, Limited (48,876).—This company's annual return was filed on May 31st, when the entire capital of £80,000 in £1 shares was taken up. 54,380 shares are considered as fully paid, and £1 has been called on the remainder. £25,604 7s. 6d. has been paid, leaving £15 12s. 6d. unpaid.

Chamberlain & Hookham, Limited (59,920).—This company's annual return was filed on May 31st, when 10,000 ordinary and 8,000 preference shares were taken up out of a capital of £100,000 in 10,000 ordinary and 10,000 preference shares of £5 each. All the ordinary and 702 preference shares are considered as fully paid; £1 has been called on 7,298 preference shares and £33,352 has been paid. [The figures are correctly quoted from the "Official Returns."—EDS. ELEC. REV.]

CITY NOTES.

The Electric and General Investment Company, Limited.

THE directors' report to be submitted to the meeting to be held at Winchester House on Tuesday, June 27th, 1899, at 3 p.m., reads:—The directors beg to submit the balance-sheet and profit and loss account for the year ended May 31st, 1899. The profit and loss account shows a gross profit on the transactions of the year of £31,744 7s. 1d., and, after deducting all general charges, and the interim dividend already paid on the ordinary shares, there remains a net balance of £25,450. Of this sum the directors propose to carry £11,450 to the contingencies fund. This will leave a balance of £14,000 available for distribution, as follows:—

Ordinary shares—	
To the payment of a dividend of 5s. per share for the year ended May 31st, 1899, of which 2s. per share was paid *ad interim* on December 15th, 1898, leaving 3s. per share to be paid	£3,000
To the payment of a bonus of 4s. per share for the year ended May 31st, 1899	4,000
Founders' shares—	
To the payment of a dividend of £30 per share for the year ended May 31st, 1899	3,000
To the payment of a bonus of £40 per share for the year ended May 31st, 1899	4,000
	£14,000

The above-mentioned payments will be subject to the deduction of income-tax.

The trustees for the ordinary shares reserve fund propose to distribute to the holders of such shares a sum of 2s. per share out of the proceeds of investments sold and dividends received in respect of such fund, making, with the above-mentioned dividend and bonus, a total present distribution of 9s. per share, or 11s. for the year, on each ordinary share. The trustees for the founders' shares reserve fund propose to distribute to the holders of such shares a sum of £20 per share out of the proceeds of investments sold and dividends received in respect of the fund, making, with the above-mentioned dividend and bonus, a total distribution for the year of £90 on each founders' share. The directors retiring this year are Mr. J. B. Braithwaite, jun., and Mr. Emile Garcke, who, being eligible, offer themselves for re-election. The auditor, Mr. G. T. Rait, also retires, but offers himself for re-election. It is proposed to make the dividends payable on June 27th, 1899.

The Telegraph Manufacturing Company, Limited.

THE first ordinary general meeting of the Telegraph Manufacturing Company, Limited, was held on Friday, 9th inst., at the Law Association Rooms, Cook Street, Liverpool. Mr. James Taylor, chairman of the company, presided, and there was a small attendance. The report for the year ending March 31st last was as follows:—

"The profit on the year's working, as shown by the profit and loss account, is £28,271 9s. 10d. Out of this sum the managing director's salary and directors' fees, £1,200, and the preference dividend, due April 1st, £2,927 1s. 10d., have been paid, and after placing to depreciation account £3,140, to reserve fund £10,000 (which includes the proportion of profits earned from March 31st, 1898, up to the date of the formation of the company), and to a special insurance fund £1,000, there remains a balance of £10,004 8s., which the directors recommend shall be dealt with as follows:—In payment of a dividend of 6 per cent. and a bonus of 2 per cent., both free of income-tax, for the period during which the capital of the company has been paid up, being in all at the rate of 8 per cent. per annum, and that the balance, £5,161 15s. 3d., be carried forward. The directors deeply regret that shortly after the allotment of shares they were deprived, owing to a sad accident, of the invaluable services of Dr. John Hopkinson, but they are pleased to state that to fill the vacancy thus caused they have secured the services on the board of Mr. J. S. Harmood Banner, whose name will be well known to the majority of the shareholders. During the period under notice the works have been fully employed, and extensions are in progress to meet the increased demand for the company's manufactures."

The CHAIRMAN, in moving the adoption of the report, said the directors had great pleasure in putting before the shareholders so good a statement of the first year's working of the company. The gross profit of £28,271 was an increase of £7,485 over the profit of the previous year, as stated in the prospectus, so that the promises made had been very well fulfilled. Under the heading of property and assets, it would be seen that freehold land and buildings, plant, &c., were put down at £70,390. That was the valuation made by Messrs. Fuller, Horsey & Co., of London. Goodwill was put down at £46,800 which they had paid for the company. In addition, during last year they had added to land and buildings, plant, &c., £9,936 in value. The amount of £3,140 put down for depreciation was what the directors considered ample, as the whole plant was in thorough good repair. The stock in trade, amounting to £72,481, might appear rather heavy, but their's was a business where they were using expensive articles, copper and rubber being the principal ones, and it was wise to have good stocks of these on hand, especially when they had such sudden rises in the prices as had recently been experienced, more particularly in copper. With

regard to the contracts for cables this year, they were fairly well covered, and since the rise in prices they had been enabled to get a corresponding increase of prices on new orders. The book debts, it would be seen, amounted to £51,710 4s. 6d. These were all perfectly good, and provision had been made if there were any doubtful ones, which he did not think there were. As to what they had decided to do with the available profit, the directors considered that in a new company like that, the best plan was to commence by making a good reserve, so that if they came upon a bad time, they would be able to meet it. They had also put aside a small sum to start an insurance fund under the Employers' Liability Act, which they considered was a more economical method than by insuring with any of the public companies. It was proposed, out of the balance left, to pay a dividend of 6 per cent., and a bonus of 2 per cent., being at the rate of 8 per cent. per annum from the time the share capital had been called up, and they proposed to carry forward £5,161 15s. 3d. They had now a large amount of work in hand, and they hoped the results at the end of next year would enable the directors to again meet the shareholders with an equally good account. He would like to say that the results achieved were not due to the directors alone, but also to the excellent services they received from the staff. Their chief engineer, Mr. Whalley, had proved himself equal to all the demands upon him. Nearly all the staff and agents were shareholders in the company, which would naturally induce them to take an interest in it. The directors did not propose to write anything off the amount put down for goodwill, because they considered if it was worth that amount last March it was certainly worth more now; but against that they were forming a reserve fund. Before concluding, he referred to the lamented death of Dr. John Hopkinson, who was a member of the board, and said they were fortunate in having secured the services in his place of Mr. Harmood Banner.

Mr. HARMOOD BANNER seconded the motion, which was carried.

On the proposition of the CHAIRMAN, seconded by Mr. WETTON, Messrs. Harmood Banner & Son were re-elected auditors.

In moving a vote of thanks to the chairman, Mr. HARMOOD BANNER said he could assure the shareholders that the company was carried on with great care, and the system was so perfect that it could be seen at a glance how each job turned out. There was no reason, as far as the directors could see, why, if trade continued satisfactory, they should not have as good profits in the future as they had hitherto made.

Mr. JOHN SHAW seconded, and the motion was carried, this terminating the meeting.

British Columbia Electric Railway Company, Limited.—The report for the year ended March 31st states that the gross profit amounts to £30,188. From this the directors have paid the debenture interest and the 6 per cent. dividend due on the income bonds up to the date of redemption. Including £208 brought forward, the accounts show a net balance of revenue of £16,575. The directors have decided to write off a further 20 per cent. of preliminary expenses, absorbing £1,218, to pay a dividend of 4 per cent. per annum (free of tax) on the ordinary shares, absorbing £8,000, to transfer £6,149 to reserve account, and to carry forward £189. In addition to the sum of £6,149, above mentioned, the directors have transferred to reserve account the surplus of premium received over the expenses of the preference share issue—viz., £1,349, bringing the reserve fund up to £12,000.

Sheffield Electric Light and Power Company.—Messrs. Franklin & Gamble, the liquidators of the above company, announce a final distribution of assets. Shortly after the Corporation completed purchase, a distribution of £17 10s. per share was made to the shareholders, with an intimation that a further small payment would be made as soon as all the debts were recovered and the accounts finally made up. The distribution now made, which closes the company's existence, is at the rate of 9s. per share. Shareholders have thus received £17 19s. in respect of every £7 share, though it should be borne in mind that the later issues of shares were taken up at a premium.

Stock Exchange Notices.—The Stock Exchange Committee have appointed Wednesday, June 21st, as special settling day, as under:—Westminster Electric Supply Corporation, Limited—further issue of £50,000 3½ per cent. first mortgage debentures, Nos. 2,001 to 2,500, and ordered to be quoted in the Official List; Electric Construction Company, Limited—further issue of £42,200 4 per cent. perpetual first mortgage debenture stock.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending June 10th, 1899, were £640 15s. 0d.; aggregate to date, £8,011 13s. 11d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending June 9th, 1899, were £3,159 10s. 2d.; corresponding period 1898, £2,899 0s. 1d.; increase, £260 10s. 1d.

The City and South London Railway Company.—The receipts for the week ending June 11th, 1899, were £888; week ending June 12th, 1898, £931; decrease, £43; total receipts for half-year, 1899, £35,118; corresponding period, 1898, £24,558; increase, £560. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending June 10th, 1899, were £182 16s. 5d.; week ending June 11th, 1898, £157 4s. 8d.; increase, £25 11s. 9d. Total receipts to date, 1899, £3,629 12s. 11d.; corresponding period, 1898, £2,834 1s. 8d.; increase, £795 11s. 3d. Miles of track open week ending June 10th, 1899, 3; week ending June 11th, 1898, 3. Car miles run week ending June 10th, 1899, 4,152; week ending June 11th, 1898, 3,297. Number of cars, week ending June 10th, 1899, 11; week ending June 11th, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, June 9th, 1899, were as follows:—D. U. T. Co., horse cars, £2,198 18s. 3d.; ditto, electric cars, £1,411 13s. 2d.; D. S. D. Co., electric cars, £1 095 5s. 5d.; total, £4,705 16s. 10d.; corresponding week last year—D. U. T. Co., horse cars, £2 861 0s. 1d.; ditto, electric cars, £471 11s. 11d.; D. S. D. Co., electric cars, £636 15s. 1d.; total, £3,967 7s. 1d.; increase, £736 9s. 9d.; aggregate to date, £81,447 12s. 11d.; ditto last year, £76,578 4s. 9d.; increase to date, £4,869 8s. 2d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending June 11th, 1899, amounted to £1,469; corresponding week last year £1,482; decrease, £13. 1898 includes Whit Monday.

The South Staffordshire Tramways Company.—The receipts for week ending June 9th, 1899, were £644 14s. 0d.; aggregate receipts for 23 weeks £14,528 16s. 2d.; week ending June 10th, 1898, £556 14s. 7d.; aggregate receipts for 23 weeks, £13,872 10s. 1d.

STOCKS AND SHARES.

Wednesday Evening.

WHILE the volume of business in electric lighting and traction shares does not show any appreciable increase, there is a "hard" tone about the market as a whole which is eminently satisfactory to its supporters. The lighting market, with two exceptions, continues very strong; traction shares are maintaining their higher quotations of last week, and the manufacturing department is hopefully anticipating fresh trade, owing to cable and electric haulage developments. Telegraph descriptions are inclined to waver a trifle, but tramway securities are being bought upon the renewed exertions of the Light Railway enthusiasts to extend their schemes in Middlesex and Surrey. Nor has the electrical railway promoter been wrapped up in home work alone. Turkey is his latest hunting-ground, and the Sultan is to be asked for concessions to build Light Railways in Smyrna and Salonica.

To particularise, the two exceptions to the general hardness of the electric lighting market are City of London and House-to-House. Judging from the quotation of Citys, there would not appear to be much change, but the price is weaker than it looks, and the Corporation's action is being awaited with a good deal of anxiety by shareholders in the City of London Company. House-to-House have exhibited a declining tendency for several weeks, and are still without support. Westminsters, Metropolitan and St. James's, are all wanted, but there has been a trifling set-back in London Electric Supply shares. Charing Cross are stationary, there being some fear that its competition in the City might not prove very profitable after all.

British Electric Tractions hold their place as first favourites in this field, but there have been a few inquiries into the Stock Exchange for Potteries Traction shares. There is no alteration to report in the price of the latter, which remains at 14½. New General Traction are dull, the Preference having sagged to 5½—⅜ upon the new issue, in which, by the way, no market has yet been made. The Ordinary shares look rather attractive as a speculative investment, for the fresh capital can hardly fail to infuse new life into the business of the company. Central Londons have followed the course we ventured to predict a few weeks back, and we look for a further relapse before the end of the autumn. There is some interesting option-dealing taking place in the shares for the end of the year, when it is fondly hoped that the new line will be ready for work. No change worth mentioning has occurred in the other electric railway stocks.

The North Metropolitan Tramways Company is energetically working for an extension of its lines in the shape of Light Railways in the direction of Edgware, Enfield and Edmonton. The price of the shares is 10 for the £8 share fully paid, and a purchaser gets nearly 5½ per cent. return on his money. Last year the quotation touched 11⅞, but the market has ever the fear of the County Council before its eyes; hence the comparatively low price of the shares. In the South-Western part of London, the London United Tramways is seeking for powers to construct a series of Light Railways in the Thames Valley, but the necessity for Parliamentary permission to be first obtained is a disappointment. Imperial Tramways shares have not, however, suffered, the price at Bristol being still quoted 25. 6s. per share falls to the lot of Bordeaux Tramways shareholders, and the dividend is considered satisfactory.

A new issue of 3½ per cent. Debenture Stock at par by the National Telephone Company has not affected the value of the shares, the price remaining at 4⅜. Telegraph Manufacturing have dropped ¼, the position of the concern, as set forth by the chairman's speech at the meeting, being thought less strong than had been anticipated in some quarters. Henley's also weakened to 25, partially in sympathy with Telegraph Manufacturing, but beyond these changes there is nothing that calls for special remark in this department.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, June 7th.	Closing Quotation, June 14th.	Business done during week ended June 14th, 1899. Highest.	Lowest
124,400*l*	African Direct Telegraph, 4 % Debs.	100	...	...	...	101 —105	101 —105	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560*l*	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 63	61 — 63	...	...
3,047,220*l*	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	112 —113	111½—112½	112⅝	111⅞
3,047,220*l*	Do. do. Deferred...	Stock	...	...	18s. %	12¾— 13¼	12½— 13	12⅝	...
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15½— 16	15½— 16	15 9/16	...
75,000*l*	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —192	185 —192	...	...
1,332,523*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105¾	105
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	...	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	102 —105%	102 —105%	104	...
60,710*l*	Direct United States Cable	20	3 %	3½%	...	11½— 12	11½— 12	11 15/16	11¾
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	102 —105	102 —105	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	...	165 —170	165 —170	168½	166
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	100 —104	100 —104	102	100½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,432,268*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —122	118 —122	120¾	120
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	16½— 17	16½— 17	16¾	16⅝
16,200*l*	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	100 —104	100 —104	...	...
64,400*l*	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	101 —104	101 —104	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	120 —124	120 —124	123	...
35,100*l*	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	100 —104	100 —104	...	...
46,500*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	101 —104	101 —104	...	...
300,000*l*	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	102 —105	103 —106	...	...
200,000*l*	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102—105%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5⅛%	11½— 12	11½— 12	11¾	11⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 16	15⅝	15½
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31½— 32½	31½— 32½	31¾	...
92,600	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	53 — 56	53 — 56	54	...
100,000*l*	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	108 —111	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	4½— 5	4½— 5	5	4½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4¾— 5¼	4¾— 5¼	4 15/16	...
1,329,471*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	100 —103	100 —103	101½	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8 xd	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	131 —136	131 —136	133	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	5	4⅞
151,733*l*	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000*l*	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	106 —109	106 —109	106	...
88,321	West India and Panama Telegraph	10	1 %	3%	...	1⅜— 1⅝	1⅜— 1⅝	1 7/16	1⅜
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10¾	10½— 10¾	10¼	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	105 —108	...	...
158,100*l*	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11 — 12	11 — 12	11¾	11¼
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	8⅜	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	114 —116	114 —116	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	15½— 16½	16 — 17	16⅝	16 1/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	15 — 16	15½	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	127	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	11 — 12	11 — 12	11¾	11
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14 — 15	14⅜	14¼
220,000	Do. 4½% Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	54 — 56	54 — 56	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5¾	5¼— 5¾	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3¾— 4¼	3½— 4	4	3 15/16
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼— 6¾	6¼— 6¾	6¾	6½
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	106 —108	106 —108	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16½— 17½	16½— 17½	17	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15½— 16½	15½— 16½	...	...
220,000*l*	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	118 —121	118 —121	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16 — 17	16 — 17	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	17 — 18	17 — 18	17¼	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4½— 4⅝	4½— 4⅝	4⅝	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½— 15½	15½	15⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation June 7th.	Closing Quotation June 14th.	Business done during week ended June 14th, 1899. Highest	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½	3 — 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18½— 19½	18½— 19½	19	18 3/16
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14 — 14½	14 7/16	14¼
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13¾— 14¼	13¾— 14¼	14⅛	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	128½	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2⅛	1⅞— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2¼— 2½	2¼— 2½	2 5/16	2 3/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	14½	14 1/16
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 11	10⅜— 11¼	11⅛	10 3/16
178,303	Do. do. do. £8 paid	10	...	...	...	8½— 9	8¾— 9¼	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3½— 3¾	3 — 3½	3 3/16	3⅛
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5½— 6	5½— 6	5¾	...
630,000*l*	City and South London Railway	Stock	1 9/16 %	1 7/16 %	2⅛ %	67 — 69	67 — 69	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¾— 4¼	3¾— 4¼	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	...	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	...	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	96 — 98	96 — 98	97⅜	97½
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2½	2¼— 2½	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	105½	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	25 — 26	25⅜	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 20	18 — 20	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	112 —115	112 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅞	21¾
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8⅝— 8⅞	8⅝— 8⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	14 — 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	40	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	105 —108	105 —108	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¾— 10¼	9¾— 10¼	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	105 —108	105 —108	107	105

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10¼.
British Aluminium, Ordinary, 10⅛—11; 7 % Pref., 12—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 105—108. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16
Smithfield Market Electric, 2—4.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, June 14th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£27	£26 15	5/- inc.
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	2¾d.	3¾d.	¼d. dec.
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 10	£6 10	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5 0	£5 0	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	3d.	¼d. dec.
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£65 to £137	£65 to £137	..
c Brass (rolled metal 2" to 12") basis per lb.	8¼d.	8¼d.	..
c „ Tube (brazed) .. .. per lb.	10¼d.	10¼d.	..
„ Wire, basis .. .. per lb.	8¼d.	8¼d.	..

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£86	£80	£6 inc.
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£86	£80	£6 inc.
g „ Rod .. .. .. per ton	£86	£80	£6 inc.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4 0½	4/1½	1d. dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	60/11	60/4	7d. inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£10 12 6	£10 7 6	5/- inc.
g Lead, English Ingot .. .. per ton	£14 7 6	£14 12 6	5/- dec.
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
l Mica (uncut slabs 8" long) .. per lb.	6/8	6/8	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£120 10	£115	£5 10s. inc.
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/7	1/7	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £65	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	⅛d. inc.
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£31 10	£31 10	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

MUNICIPAL ELECTRICAL ASSOCIATION.

Presidential Address, Delivered at Bristol on Wednesday, June 14th, by Mr. H. Faraday Proctor.

We are met together to hold our Fourth Annual Convention, and, according to custom, I have as your President the honour of addressing you before we proceed to the real business of the meeting; the receiving and discussing of papers contributed by members of the Association on subjects relating to, or affecting, municipal electrical enterprise.

As this Association has very little past history there is correspondingly little food for remarks upon the subject of its completed works, I therefore propose to just touch upon some of the matters now in hand or requiring early attention.

The primary object of this Association is to guard and promote the interests of municipalities in connection with electrical matters in general, this being brought about chiefly by the interchange of ideas and experiences. At such meetings as the present we have the opportunity of discussing each other's ideas and generally enlarging our own, as well as enlarging or directing the minds of the public.

We have a very full programme before us; it is a matter of regret that a longer period than three days cannot be allotted to the ordinary business of our meeting. Great good results from the meeting together of councillors and engineers interested in the development of electrical enterprise; this alone is full recompense for the energy spent in the working of our Association.

There are now 83 municipalities operating electric lighting works, and of these 61 have joined this Association, including most of the principal cities; the total membership being now 208.

The growth of this Association fairly represents development of municipal working. When our Association held its first convention three years ago, 134 local authorities had powers to work electrical undertakings, whilst now there are 235. During the same period the number of companies with such powers has only increased from 64 to 81.

The total capital expended by local authorities having works in operation is now about £5,000,000, of which sum £4,500,000 is at present represented by our Association.

The scope of municipalities as traders is being more keenly discussed now than it ever has been before, but no matter what limitations may be made, it seems certain that municipal enterprise will continue to increase as regards what may be termed the large monopolies, water, gas, tramways, electricity, and telephones.

The action of the Government in connection with telephone matters foreshadows what would probably result if large schemes for electric power distribution were also sanctioned. If later on such schemes should be allowed to proceed, it appears likely that the companies would ultimately combine and form a huge monopoly like the National Telephone Company.

In the case of public requirements municipalisation seems to spring up as the natural course between the formation of huge monopolies and ruinous competition. Even where companies do not combine healthy competition is not secured, owing to the working being such as we have in the case of insurance companies, where a ring is formed, a tariff drawn up, and an end put to competitive tendering. When company work reaches the stage now arrived at as regards insurance, it is time that such work be municipalised or taken up by the Government. In the case of insurance, I would advocate a Government department. The risks would be better divided, and sufficient experts could be more easily retained.

It is desirable that all public streets should be under the complete control of the public authority, including any works that are executed under their surface, more especially if the occasional or frequent disturbance of the paving is necessary in connection with such works.

Under the main arteries of a large city subways should be constructed for the passage of pipes and cables. Were all these under one control, it is likely that such would be formed, but while the responsibility for the streets is divided between the local authority and two or three companies it cannot be expected that such arrangements will be made.

Where works are restricted to the district of one local authority, they should be in the hands of that authority. If they are spread over the whole country, as in the telegraph system, they should be in the hands of the Government. If the works extend to the districts of two or more local authorities, they should, as far as is reasonable, belong respectively to the different authorities.

It is often argued that a Corporation or Vestry cannot manage a commercial undertaking as well as a private company, and that there is not the same continuity or even intensity of interest; if this is so, would it not point to the desirability of a change of system regarding the appointment or term of office of the councillors or vestrymen? Speaking impartially as a consumer of electricity, I would say, if the members of the Corporation cannot manage the electric lighting, get rid of the members, but leave the electric light. But is it so? A company is not usually managed by the individual directors, though it may be by one of them, and a change on the board does not alter the tactics of the whole company, so long as the actual managers remain. The same applies to working under a municipal committee; the actual management is, or ought to be, carried on by the permanent official. It is possible, and even likely, that some slight change may occur in the committee every year or two, but the leading members usually remain for much longer periods; the weakest point in the municipal management of electricity works at the present time is the unstability of the so-called permanent official, more appropriately termed the engineer. It is more important to a Corporation than to a company that its official should remain during an extended time, for the very reason that changes are more likely to occur on the committee than on a board of directors, and yet how often these changes are allowed to occur in the case of electrical undertakings!

The cause of this continual moving about is not difficult to trace. A few years ago, whenever a scheme of electrical equipment was required, a consulting engineer would be engaged who would probably be retained for some years after the permanent engineer had taken up his duties; the most common practice now—judging from the technical press—is to advertise for the permanent official at once, and require that he be capable of designing and drawing up specifications for the works; the salary attached to such an appointment would naturally be greater than that of an engineer engaged for superintendence only; consequently many engineers will apply for the post advertised who have been appointed on the old lines, although they perhaps have at the time the whole responsibilities of the design of new works without such extra services and responsibilities being recognised. The common practice in many towns is that an official shall not receive increased emoluments unless he is in possession of an offer of an appointment elsewhere.

Reference has been made to the fact that consulting engineers are not now so often engaged to arrange the preliminary portion of an undertaking as hitherto. In many instances this is ill judged, as in the case of undertakings where there is no reasonable prospect of great development at an early date the services of a permanent official with really good qualifications cannot be reasonably obtained; it would therefore be much better that an experienced consulting engineer should be employed.

The more difficult instance is that of a municipality owning an electric lighting undertaking and a tramway to be converted or constructed for electric traction. The tramway engineer, if such exists, wishes to keep the whole of the works in his own hands, and the consulting engineer cannot shut his eyes to the fact that if he advocates a system distinct from the existing electrical undertaking he will probably be engaged to carry the scheme into effect. But if he expresses a decision in favour of combining the electric traction with the electric lighting works, his share in the organisation of the new system is likely to be very much less, and his fees will be affected in a similar manner. On the other hand, if the municipal electrical engineer be consulted he may be slightly prejudiced in favour of a combined system, but not necessarily so, as there should never be more than one chief electrical engineer in the same area, and thus the electrical section of the works, whether they be lighting, tramways, or power distribution, should in any case come under the one man. The solution of the difficulty seems to lie in the direction of the employment of the consultant on a pre-arranged scale, such not being dependent in any way upon the combination, or otherwise, of the systems.

A scale of fees, based upon the miles of track to be equipped, would be as fair and workable as the existing payment by commission on the amount expended. At the same time this would not be conducive to excessive expenditure, as is the case with the existing scale.

The same principle might with advantage be applied in connection with other works such as buildings, with a view to economy as regards capital outlay.

Turning to the question of revenue charges; there is a great deal to be learned from a careful analysis of the working of undertakings which cannot be abstracted from any existing tables or other publications. We are all required to make returns to the Board of Trade, showing the results of our annual working on similar lines, but these returns do not go far enough to be of much value to the engineer as regards details, and unfortunately the Board of Trade does not tabulate and publish the returns so made. In returns published certain works are shown as having attained excellent results in one or other detail of costs, but there are no direct means of discovery how the results are arrived at. In one case fuel may cost next to nothing, and in another it may be charged at too high a price. Either of these errors may arise when fuel is obtained from the Corporation gasworks; the question being how much of the expense can be fairly allotted to the gasworks and how much to the electrical. Under the heading of management there may be next to no charge for accountancy, expenses, &c., these being under the control of the city or borough accountant's department, and perhaps charged in with rates and taxes or not charged at all. In one instance where an undertaking made a record during its first year of operations the results were aided by charging practically the whole of the chief's salary and a considerable portion of the assistants' to capital on account of extensions that had been carried out. On the other hand there are many instances where the supervision of capital works is entirely charged to revenue. It is an unfortunate fact that the record-making stations have not generally been those whose supply is praised for its regularity, and the detailed records kept are very meagre. The log sheets as a rule contain little information of real value, whereas they should be the principal source of information and subject of analysis. The council of this Association has made one fruitless attempt to get a table compiled that would meet the want felt. Another attempt will shortly be made, when it is hoped that the general body of members will respond not only by supplying data regarding their own works, but by offering suggestions for the improvement of the forms issued. There is doubtless a considerable amount of labour involved in collecting the information required, but this is slight compared with the benefits derivable.

A task which this Association should take in hand at an early date is that of drawing up a scheme for the appropriation of charges under the headings appearing in the Board of Trade returns, and such subheadings as seem desirable.

Though we cannot look back upon great achievements, an important reduction of fire insurance rates has resulted from the efforts of the Association; but taking into account the very small amount of inflam-

mable material used in up-to-date works, the rate ought to submit to a further considerable reduction.

Insurance companies would do well to turn their attention more carefully to the question of the wiring of private premises. This Association, instead of drawing up wiring rules, as was originally proposed, has joined the Institution of Electrical Engineers in this matter, but little has been said as to the method of ascertaining whether attention is paid to the rules in individual instances.

When reading a paper before the Bristol Insurance Institute, about six years ago, I advocated the appointment of an inspector, or inspectors, by insurance companies jointly, such inspectors to supervise electrical installation work during progress, the fees being paid by the different companies in proportion to their respective interests in the buildings inspected. Such appears to me to be the most reasonable way of safeguarding at once the consumer and the insurance company. At the present time the usual practice is for the cheap wiring installer to persuade the consumer that the insulation test taken by the corporation (or supply company) is sufficient guarantee of good work, whereas it affords little or no protection whatever, and is often taken merely to fall in with the Board of Trade regulations, which require the suppliers of electrical energy to be satisfied that there is not excessive leakage on a consumer's premises.

The Board of Trade, as you are all aware, has recently introduced a Clauses Bill before Parliament with reference to electric lighting. The avowed object of this Bill is merely to save the frequent reprinting of exactly identical matter by codifying model clauses; there are, however, some alterations from the existing model form. For instance, there is a re-arranged clause excluding the month of August from all consideration in the service of notices upon the Postmaster-General. Though why Post Office holidays to the extent of one month should be allowed for in an electric lighting Bill is not quite clear.

On first hearing of the existence of this Clauses Bill, a sub-committee was appointed to consider the same, and report to a special general meeting of this Association, if necessary. It was subsequently thought desirable to approach the Board of Trade with a view to certain amendments.

Although they have been approached by the town clerk of one of our largest cities, by this Association direct, and by a member of Parliament, the Board of Trade decline to receive a deputation, or consider any amendment of the Bill, as they consider the slightest alteration would probably lead to its rejection for this session. They have at the same time pointed out that all amendments may be made in each of the special orders as hitherto.

The passing of this Bill would make it much more difficult to get any desirable amendments authorised by Parliament, whilst there would be little gained by anyone.

It were well, therefore, that the Bill should be thrown out until such time as it can be presented in a complete condition, dealing with all matters requiring reform. In the meantime we should all carefully consider the matter, that we may be prepared to deal with the whole question when it comes up again. Partly from lack of time it was in the present instance considered expedient to let the lesser items drop, devoting our energies almost exclusively to the insertion of a stand-by clause.

The question of the period allowed for the repayment of loans is one requiring early attention. There is a great diversity in the practice in different places, and the term authorised varies to an extent which is extraordinary when taken in conjunction with the fact that the loans are for works having a similar character of permanency.

For instance, for depreciation and sinking fund Glasgow sets aside at more than 20 times the rate per cent. provided by the Belfast Corporation. The most usual period allowed by the Local Government Board is 25 years, this being a very much shorter period than is usually authorised by other authorities.

The average annual amount set aside for electrical works by provincial municipalities being 2½ times greater than that provided by the different metropolitan authorities, it would be well that the Act should define the period over which any loans authorised are to extend, having regard to the permanent nature of the undertaking, and to the arrangement that the value of the works shall be maintained from revenue.

In deciding the period of repayment, the Local Government Board take into consideration the life of the particular article in which the capital is to be expended; but this is surely an erroneous principle, as it makes provision for the replacing of worn-out material from further capital, a method which certainly cannot be commended, and is not, I believe, practised. Provided the works are properly maintained, the whole system must have one degree of permanency. There ought, therefore, to be no difficulty in coming to a decision as to the term of years applicable to the repayment of loans for all electricity works used for similar purposes. Whatever term be authorised, the first repayment should not fall due during the first year or two years after the loan is contracted, for it is the evident intention of all parties concerned that the undertakings be self-supporting, and under the present system of making the first half-yearly or annual repayment within a year of the money being raised, there must be a call upon the local rate, since the first instalments fall due before any revenue can be earned.

I have one other matter to bring before you, in which I trust you will all take a personal interest.

At the suggestion of your past President (Mr. Wordingham) a benevolent scheme has been prepared.

Through the kindness of the Institution of Civil Engineers we have modelled our scheme upon that of the older institution. The fund to be raised is for the assistance of persons who have been members of this Association, or of their families. The fact that such a fund is not immediately required to be drawn upon renders this the most appropriate time for its inauguration. While we are young and vigorous we should lend such support as our means will permit to a fund in the interests of those who labour in the same field as ourselves.

The particular branch of the profession to which we belong, even at this early state of its existence, is over-crowded. It is difficult to enter, as in addition to a scientific education, an apprenticeship to engineering should be served before entering a generating station, even in the capacity of a pupil or improver. Not only does this mean the payment of a premium twice during the course of training, but what is much more serious, the occupation of a considerable number of years, at the end of which the individual is at best only qualified for a position of charge engineer. For this position the salary at first would not exceed £2 per week, perhaps even less, and, therefore, there are likely to be many in the ranks who cannot make adequate provision for misfortunes which may come to them. Under the scheme at present arranged an annual subscription of 5s. will secure one vote at all meetings, I should much like to be able to announce before the close of our meeting this morning that every member present had undertaken to subscribe *at least* 5s. annually (which sum, I would point out, is only about 1d. per week). Though the disbursements are limited, the source and amount of subscriptions and donations is in no way controlled.

In conclusion, I beg to express the desire that from our gathering this summer you may all reap instruction, pleasure, and health. There is, I think, no more fitting opportunity than the present for me to mention that the thanks of the Association are due not only to those whose hospitality we are accepting, but to others who have extended invitations which we would most gladly have taken advantage of, had time allowed, amongst whom I may mention the Corporations of Cardiff, Exeter, Newport, and Taunton.

APPROPRIATION OF PROFITS AND REPAYMENT OF LOANS.

By Bailie Maclay,

Convener of the Electricity Committee of the Glasgow Corporation

My last paper on the "Appropriation of Profits and Repayment of Loans" created an amount of interest for which I was unprepared, and it was subjected to pretty severe criticism by those who advocate the application of the profits of municipally-managed gas and electricity undertakings in reduction of rates and taxes. Careful reconsideration of the subject, giving all due weight to the opinions of the speakers who followed me and of the public Press, does not at this day materially alter my conclusions as then expressed, and though I am prepared to admit that it would be sound policy for the Corporation of Glasgow to vote on a special occasion, say, a sum of £5,000 or £10,000 out of the gas or electricity profits to be applied to effect some local public improvement for the benefit of the general body of ratepayers, I contend that it is neither good nor sound finance systematically to keep up the price of gas or electricity in order to transfer annually large sums in relief of rates. It is well known that some corporations have for many years taken large sums out of gas profits. The mere fact that in the electric lighting provisional orders, the power to do this is restricted to a profit of 5 per cent., shows that the Legislature had become aware that an excessive amount had been taken out of gas consumers, which called for safeguards in the case of the more brilliant illuminant. Much was made of the fact that it is the ratepayers who are responsible for the debts of gas and electricity undertakings, but it is forgotten that these undertakings when efficiently managed, are so eminently profitable that the risk of any recourse to the rates is infinitesimal. Further, *the consumers* pay for reserve and sinking funds, which will in the course of time leave the ratepayers in possession of remunerative undertakings absolutely free of debt—going businesses—in a word, excellent assets. Is not this giving the ratepayers generally an interest, and a good interest in the profits of a department, in return for their pledged credit in borrowing transactions?

The most serious charge made by my critics, was that the Corporation of Glasgow had in some way evaded Board of Trade regulations, and had created a number of small reserve funds that they were not entitled to have. I was at a loss at first to know what funds were aimed at, but I suppose my critics were striking at the depreciation written off the land, buildings, machinery and plant items in the capital account.

In reply, I have simply to say that the members of the Corporation of Glasgow would be sadly wanting in ordinary business capacity if they allowed either their gas or electricity accounts to be stated without an adequate amount for depreciation and renewal of all wasting or wasted assets being debited against revenue. I think the charge of evading Board of Trade regulations is absurd, and in this connection I have simply to say that the Glasgow Corporation Electricity Departmental books and accounts are audited and approved by one of the most eminent firms of chartered accountants in Scotland. A full abstract of these accounts, stated on Board of Trade lines, and setting forth all depreciation and sinking and reserve funds, is sent to the Board of Trade annually. The Board of Trade have not offered any observations on the accounts, and I feel justified in saying emphatically that certain of my critics gave utterance to an unfounded charge, which closer examination of the facts before speaking would have dissipated. I believe that there is a growing feeling in English municipalities in the direction of letting "every herring hang by its own tail," and probably Glasgow's example will be followed more and more every year. Undoubtedly the transfer of large sums from remunerative undertakings tends to hide from the ordinary ratepayer any extravagance or failure to economise in purely spending departments. Many councillors would resort to any shift rather than

incur the odium of raising a rate. The departmental system of management under the Corporation of Glasgow prevents a "hotch-potch" being made of rates and revenue, and a healthy rivalry grows up between departmental committees, which in the end tends to make rates, taxes and charges correspond somewhat with the "value received" by ratepayers and consumers.

THE INSTITUTION OF CIVIL ENGINEERS' CONFERENCE.

SOME NON-INTEGRATING ELECTRIC METERS.

By Prof. WILLIAM EDWARD AYRTON, F.R.S., A.M.I.C.E.

Materials.—The five most important metals employed in the construction of electric meters are copper, iron, steel, phosphor bronze, and some alloy of high resistivity. A few years ago copper of 98 per cent. conductivity (Mathiessen's standard) was considered good, now it is stated that copper of 105 per cent. conductivity can be obtained commercially from Mouchel, of France. The great increase in the electric conductivity has been attributed to greater density of the material; but there seems to be considerable doubt about this, and it is desirable to try whether a still further electric improvement, possibly even a relatively large one, might not be produced by using much greater care in removing the last traces of impurities. It is also important to find out exactly how the variation of resistance with temperature increases with increase in the electrical purity.

Soft iron for needles of electrical instruments should have small remanent magnetism and small coercive force, while both these qualities should be large in steel for permanent magnets. A large magnetic improvement has been effected in commercial soft iron during the last few years, and even steel can now be purchased in ingots having a far smaller coercive force than the so-called "soft" iron practically employed for electric apparatus six years or seven years ago; and by constructing the meter so that the magnetic induction is kept low, soft-iron instruments may be used for measuring alternate currents and pressures with fair accuracy. It should be remembered, however, that although the number of turns and the maximum scale reading may correspond with a number of ampere-turns which produce only a small induction with a sine or a flat wave, such instruments may read wrongly if the wave be peaked. A satisfactory compensation for variation in the frequency is effected by shunting the instrument with a self-induction, and experiments should be made to devise some such device to compensate for the wave having a peak.

The manufacture of steel magnets has much improved during the past few years, as indicated by the following results obtained from tests on steel magnetised with a force exceeding 200:—

		Residual magnetism.	Coercive force.
1885.	Oil-hardened steel tested by Dr J. Hopkinson	11,300	12
1893.	Glass-hard pianoforte wire tested by Prof. Ewing	9,500	45
1898.	Molybdenum steel tested by Madame Curie	...	85

This marked increase in the coercive force, which is of great importance in preserving the constancy of permanent magnet types of measuring instruments, has been brought about partly by improvement in the composition of the material, and partly by greater experience having been gained regarding the proper way of hardening magnets. Still greater improvement may certainly be anticipated.

In instruments employing a spring control, and in which, for magnetic reasons, steel cannot be used, phosphor bronze is the best elastic metal, but it is far excelled by quartz as regards the absence of sub-permanent set. A really satisfactory method of coating quartz with even a metallic layer of sufficient conductance to serve as the flexible electrode for an electrostatic voltmeter using a spring control is very desirable, but better still some metallic alloy possessing the mechanical properties of quartz is well worth seeking.

Alloys possessing higher and higher resistivities and smaller and smaller temperature coefficients are being constantly brought to notice, but no one seems to be seeking for a substance with a small temperature coefficient and a small resistivity, although that is the kind of substance that is needed for many purposes, as, for example, to wind voltmeter coils with and the bobbins of moving coil instruments used with a shunt for the measurement of large currents.

Galvanometers.—The moving coil type of instrument has effected a revolution in galvanometry, and where low resistance and short period are desired it greatly surpasses the moving needle type. No moving-coil galvanometer, however, has yet been constructed that will even indicate the existence of the small currents which certain moving-needle galvanometers will measure accurately. Development of the moving-coil type of instrument is at present limited by the comparative smallness of the field produced by a permanent magnet, the limiting thinness that can be given to the strip of metal used for the suspension, and the slight trace of magnetism that remains in the, so-called, non-magnetic materials, used in constructing the coil, even after the application of the best method for freeing them from magnetism. In view, however, of the great improvements that have been introduced into moving-coil types of galvanometers during the past few years, and of the fact that a given volume of wire possesses such an enormously greater value in the moving coil than in the ordinary moving-needle type of instrument, it may not be too sanguine to look forward to moving-coil galvanometers rivalling moving-needle galvanometers for all purposes.

Ammeters and Voltmeters.—Instruments depending on the action of one coil on another without iron generally use a working field of about 50. Therefore, since the field on a central station switchboard often exceeds 20, the disturbance may be very great. Indeed, the error arising from the current in the leads alone of such an instrument may be serious. The importance of using copper of much higher conductivity than at present obtainable, so as to employ many more convolutions of wire without increasing either the volume or the resistance of a coil, is here manifest. Some soft-iron needle instruments have also fields not exceeding about 70, and are, therefore, quite useless for central station work, unless protected in special ways with soft-iron magnetic shields.

The field in which the coil of some moving-coil instruments turn is as high as 1,200, and it might be expected that small stray fields would produce no error. But, as a matter of fact, the iron pole pieces, and especially the iron core, concentrate the stray field on the coil, so that a stray field of only 0·5 when parallel to the field of the instrument, may produce an error of 0·4 per cent., or nearly 10 times as great as the ratio of the fields alone would lead one to expect. The employment, however, of an astatic pair of narrow coils without an iron core greatly reduces this error.

For measuring large alternating currents it is desirable to employ a small transformer giving a maximum secondary current of some 10 amperes, which can be easily led to an ammeter at a safe distance from the main cable, and by keeping the resistance of the secondary circuit low, the transformation ratio will not be affected by changes of frequency. The best way at present of measuring small alternating currents is by means of an electrostatic voltmeter shunting a non-inductive resistance.

Electrostatic voltmeters have practically no errors due to stray magnetic fields, unless they are rapidly alternating. In that case, unless the needle and inductors be properly sub-divided, eddy currents may be induced and a disturbing force introduced. The error due to impedance is practically zero, as the capacity of a dead-beat electrostatic voltmeter with a 12-inch pointer need not exceed about thirty-millionths of a microfarad. Pivot friction and brush discharge between the needle and inductors introduce the greatest troubles, and it is difficult to obtain as much damping as is desirable. Coating the inductors with mica, enamel, &c., greatly reduces sparking between them and the needle, but not the brush discharge with an alternating potential difference, and is, therefore, of little practical use. A better method of stopping the brush discharge than by immersing the whole instrument in oil is much needed.

Megohm-meters.—Direct-reading ohm-meters, measuring up to 50 megohms, are now obtainable, but apparatus is also needed to enable the insulation of an electric light cable to be tested where laid. At present cable is often supplied which, although possessing only a fraction of the specified insulation, is passed because suitable testing apparatus can be used only in a laboratory.

My cordial thanks are due to Mr. A. Campbell for assistance rendered in the preparation of this note.

Prof. AYRTON's paper was intended to be read in abstract, but was really rendered longer by the verbal notes interpolated by the author.

He exhibited an exploring coil for use in examining the fields of dynamos, and that in the neighbourhood of switchboards, &c., and produced a board upon which he had mounted specimens of flexible wires and insulated cables, which had been supplied to come up to a certain specification which required an insulation resistance of 300 megohms per mile for flexible wire, and 2,000 megohms for the cables; he had tested the samples, and the details of results were given on the board. The insulation resistance of the flexible wire varied from 4,500 megohms in one sample to 0·001 megohm in another, and that of the cables varied from 4,300 megohms in one case to 277 megohms in another. It was very desirable that some instrument should be brought out which could enable the consulting engineer to have the cables and wires tested upon the job itself.

Mr. EVERSHED opened the discussion by pointing out that ever since 1886 he had been endeavouring to get perfectly soft iron without hysteresis for use in instruments. He tried ferrotype plate, tin plate, and all other varieties, but could find no suitable iron. Prof. Ferraris had described a magnetic oxide with no coercive force, but he got a sample and found the statement was a delusion. He dissolved iron in mercury, but with no better result. He also obtained a sample of chemically pure iron and found the coercive force equal to that of cast-iron, and he could now get iron better than the old ferrotype iron and with a coercive force of only 1·5. The author's table was rather misleading. All the good alloys for resistance coils were made in Germany. He then described some of his own instruments and said the fields in the small sizes were about 1,200, and in the larger sizes about 2,500. He thought artificial jewels might be better than the sapphires now used, as scratches were now left in. There was no satisfactory electrostatic voltmeter for 100—110 volts, and this type was, in his opinion, of no use for pres-

sures below 1,000 volts. He had used a Kelvin electrostatic voltmeter for 10,000 volts, and at 13,000 volts it sparked across to the needles.

Mr. Crompton agreed that suspended coils give greater accuracy than is possible with moving needles which were useless in the ordinary laboratory owing to the stray magnetic fields. No great improvement had been made in steel for six or seven years. As to testing cables it was a mistake to specify too high an insulation resistance, as such cables would probably rapidly deteriorate while those of moderate insulation resistance would probably be more lasting.

Major Cardew regretted that at present it was quite impossible to judge as to the permanency of the magnetism in magnets used for example in electricity meters, so that these instruments could not be absolutely relied upon. An electrostatic voltmeter might give an inaccurate reading merely owing to a little slackness in the connections of the wires to the terminals. He advised Lord Kelvin to use iridio-platinum for the suspension in his instrument, but found it impossible to get the fatigue out of the metal.

Mr. Hammond thought it desirable to fix upon a definite chemical composition for what had been termed somewhat vaguely "soft iron."

Dr. Kennedy thought the cable makers should not be blamed; he believed they had introduced certain materials into the India-rubber with a view to improving the insulation resistance, but he feared that these materials had caused breakdowns. They were, however, greatly indebted to cable makers.

Prof. Ayrton, in replying, laid stress again upon the desirability of having an instrument for actual testing of cable while it was being installed.

THE RELATIVE ADVANTAGES OF DIFFERENT KINDS OF POWER FOR TRAMWAYS, LIGHT RAILWAYS, AND MOTOR CAR TRAFFIC, BOTH HEAVY AND LIGHT.

By Thomas Parker, M.Inst.C.E.

This effort to deal with the subject indicated by the title of this paper is intended to induce discussion; to obtain data of the various methods and points of interest, and place them on record.

Horse-Traction is the oldest method by which tramways have been operated, and there are ample data available. Its slowness, the occupation of a great length of the road, and the bad sanitary conditions caused by the refuse from the animals, the element of risk in the temper of the animals, variable cost of food, the great destruction of the horses by the very heavy work. These facts and conditions, by long usage, have become unnoticeable, and do not appear to come within the scope of public vision, when judging of the efforts made by engineers to replace the horse by mechanical means. But the always present cash quantity has condemned horse traction on tramways.

For cost of tramways operated by horses taken under average conditions, see Table, page 999.

Steam is quicker than horses, less costly for results, but has greater disadvantages, viz:—Much greater weight, and occupying greater length of road, the emission of carbonic acid, carbonic oxide, sulphurous acid, steam and smoke, practically into the dwellings along the route, and among the people, the unsightliness and noise, make its use in public streets a painful burden to the community, and, as experience shows, not to be borne when better means can be found. The objections leave little hope for the future of direct steam-driven tramways.

The appended costs are taken carefully from practical workings, see Table, page 999.

Compressed Air is a more congenial agent, and has better prospects of success than steam, if the two had to settle their differences alone.

It is free from many objections compared with steam. There is little interference with the atmosphere. The small amount of direct firing makes it possible to use only one carriage for motor and passenger; water need not be carried. The total dead load to passenger is in its favour. It needs frequent stations for supplies, as the distance it is possible to run with one store of pressure is limited. Its friends are very active at present, and it is hoped we may hear their case and obtain some practical account of its working. It appears to have higher economy than can be obtained by steam direct. The author has no working data he can give.

Cable.—Endless cable, as a method for driving tramways, has high merits in many respects. It occupies a minimum length of road. Its speed is fair. It is free from nuisances of steam or horses, and it is handy. Its drawbacks are: heavy initial outlay; its occupation of the street; the slot difficulty, of carrying sewer and other requirements in or across the street in which it is laid; the continued noise of the running rope under the streets causing, in some instances, considerable depreciation in value of property; the stoppage of the whole system upon the breaking of the cable, and the heavy costs attendant upon the system. Taking the statistics of installation, there are very few cable roads being put down now, and we may accept the verdict of the public that the cable has ceased to compete successfully with other methods.

There are some tramways being driven by gas engines working on the car, but no reliable practical data are available. The verdict of passengers is, that they are required to inhale considerable admixture of coal gas with the atmosphere in the neighbourhood of the cars.

Electricity.—At the present time electricity is, by general accord, selected as the best method for driving tramways. In electricity we have a very flexible system which admits of great variation of powers being used at varying points on the same system. There is no nuisance, as with steam or horses. The minimum length of road occupied; speed can be low for inter-town work and high for suburban traffic; cars are easily handled; energy is used efficiently; maintenance is not excessive; streets are not more occupied than simply by the pair of rails, so that taking up streets for laying sewers and pipes, or other needs, is not complicated. The disadvantage is the conductors being carried overhead. Conductors have been used in other forms, but it appears fairly settled that the overhead wires, by their small first cost, the simplicity and security of insulation, and the readiness with which repairs can be carried out, are accepted, at least for the present.

Accumulators have been introduced on to cars the carry them through the crowded streets, being charged whilst in the suburbs, running from the line, and discharged by inter-town running. Accumulators have been installed on their Bournbrooke section, by the Birmingham Central Tramways Company; but, although still running, have not met expectations. The loss of capacity of the cell under the conditions of use was a great difficulty.

The energy required to drive the accumulator cars was approximately 4·6 H.P.-hours per car-mile, whilst the quantity of energy necessary to drive a car of equal capacity with overhead conductors, is 2·15 E.H.P.-hours per car-mile, the speed being much faster and the gradients heavier.

Railways, Light and Heavy.—Electricity as a means of driving light or heavy railways is under best conditions if employed for long runs, and under its most inefficient conditions when called upon to make frequent startings. There is by the steam locomotive practically the same energy economy with one journey per day as 50 journeys per day. For electricity it is necessary first to put down the motive plant, dynamos, and conductors, throughout the system, and to provide the motors for hauling the trains. For lines where few trains are required, electricity does not compare with steam, as the capital outlay for running a few trains is the same as for running a number.

If we take a case, say, of two towns 50 miles apart, such as London and Brighton, which would support a continuous connection, and by the length of run put electricity under good conditions, electricity could give 15 minutes-interval trains, and run at 75 miles an hour, doing the distance in 40 minutes by trains of 100 tons, at 2½d. per train mile, covering costs of power. Such a case shows how completely electricity takes the field under fair conditions, and the advantages are not only in point of power, cost and speed, but the track need not be so costly, as the weight can be evenly distributed throughout the train, the weight of the train being brought in for adhesion and traction. A 100-ton train would be equal in capacity for passengers to a steam train of 140 tons. The cost of maintenance of permanent way and risks would be much reduced.

If we turn to a case where electricity is under its worse conditions in comparison with steam, we are able to refer to well-matured data. The Liverpool Overhead Railway is such a case. It has been running for nearly seven years, and is in direct comparison with a number of similar lines worked by steam.

A most important difference between electric motors and the steam cylinder when starting into motion is, that in the electric motor no effort is obtained unless current is passing through the motor, and the torque is proportional to the quantity, while steam gives its efforts and is liberated to exhaust only in proportion to motion.

Motor Cars.—Steam was early in the field, but the requirements needed to make moderate success possible are only of modern achievement. The conditions of the vehicle and road make still further variation of the boiler, engine, and condenser necessary before the steam motor car can be a standardised article of manufacture. With regard to gear, steering, brakes, and wheels, there are openings for improvements and new applications.

There are some good approximations to success of the steam type.

Oil Cars.—Much has been done to render tolerable the close association of passengers with mechanical movements and rapid explosions forming the combination we call an oil car. Still much is needed with regard to safety from explosion and fire, reduction of vibration, and efficient transmission. The prospect is that it may be practicable, with reasonable first outlay, depreciation and cost of fuel, to run an oil car successfully for a much less cost than horses. The movement has brought about great improvements in the oil engine, but only light oils have been successfully used. Electricity is chiefly used as a means of igniting. Speeds of 1,000 revolutions are obtained, or 500 explosions per minute.

Electricity.—In applying electricity to motor cars, we first met the question of weight of accumulators. This has, by improved motors, gear and accumulators, within very recent date been reduced to 1 H.P.-hour delivered on to the car at about 56 lbs. inclusive, so that 5 cwt. of cells is sufficient to operate a car, as against 16 cwt. two years ago. Motors, gearing and methods of steering have been much improved. The following data are from one of the best examples I have had the opportunity of testing:—

Weight of car, complete, without batteries ...	9 cwt.
„ batteries	5 „
Total	14 „
Total weight, with four passengers	20 „
Discharge, on level, 12 amperes at 80 volts ...	9 miles per hour.
Approximate H.P.	1½
Safe distance	40 miles.
One motor, double reduction gear	1,200 revolutions.

Operative Costs of Running One Car-Mile by the Different Systems enumerated

——	Horse traction.	Steam traction.	Cable.	Electric Overhead.	Liverpool Overhead Railway.
	d.	d.	d.	d.	d.
Drivers' and conductors' wages ...	2 5	3 5	2 67	2 49	
Generating station, including coal, oil, wages, waste, &c...	...	...	...*	0 46	
Repairs, locomotive engines	...	1·75	...	...	
Motors	...	...	...	...	
Machinery	...	...	0 84	...	3 9
Cars	...	0 50	0 42	0 037	
Harness, &c... ...	0·92	...	...	...	
Fuel	...	1·65	0 25	...	
Lighting	0·02	0·33	0 04	0 02	
Horses, including forage, shoeing, attendance, renewals, &c. ...	3 61	...	...	...	
Management: General expenses	0·73	1·26	0 18	0 15	0·416
Total ...	7·78	8·93	4 40	3 157	4 316
Carrying capacity ...	26	54	54	30	140
Weight empty ...	2·75 tons	12 tons	4·7 tons	4·3 tons	31 tons

* Could not obtain reliable figures for generating costs.

Mr. Thornycroft said that the subject of this paper was one of great interest to engineers. Mechanically propelled vehicles on common roads formed an important section of traction, and in that section steam would play an important part. He considered that electricity was mainly of use for long runs, and that it could not expect to absorb the whole field of traction. The law restricting the weight of a road vehicle to 3 tons was, he considered, too stringent, and at least 1 ton more should be allowed. He regarded electricity as being of great advantage in certain cases where the moving cars could conveniently be connected with stationary machinery by means of a wire, but this excluded electric vehicles on ordinary road service. Accumulators on road vehicles, he thought, ought to be included in the weight of the vehicle, as is done in the case of the boiler in steam-driven vehicles. Steam car builders were obliged to use very expensive materials for their machinery, such as aluminium and high-grade steel, in order to cut down the weight of the vehicle.

Mr. A. L. Steavenson, of Durham, said that this paper appeared to raise the whole question of haulage, and that as it included light railways, it seemed to him that a mining engineer's experience with those underground would not be out of place. So long ago as 1867 he had indicated an underground hauling engine, first with a full load of 45 half-ton tubs, and afterwards with none, the main hauling rope being coupled to the tail rope by which the empty waggons are pulled inby, and found that the work done in hauling the full ones alone amounted to 56 per cent. of the total load with the ropes and waggons together; this was with a gradient of 1 in 31 against the load, and with wheels not exceeding 10 inches. The writer of that paper thinks that the cable system, owing to its heavy cost, has ceased to compete with other systems; apparently that is so, but have other systems been sufficiently long in operation to enable their full cost yet to be accurately known? What do we yet know of the effect of 10 years' running upon boilers, engines, motors, and gear wheels, where there are any; on the tramlines and adjacent pavement when in the hands of private companies? Has sufficient allowance been made for these things when making such comparisons? Time is required to prove it. With respect to the horse, it may be admitted, as the writer says, that the question of cost has condemned horse traction, but before dismissing such an old servant, it may be well to glance at one of the causes of the early breakdown of horses when used for tramway work. In 1887 he had occasion to test the work which some very fine 17-hand mine horses were doing, for this purpose he fitted up a dynamometer, and now produced for the first time one of the diagrams he then took. By this he was enabled to show what a powerful horse can work at during a short time, and also the dead pull at the first lift away, and for a special test by spragging the wheels he ascertained that for a distance of about 30 yards a horse can do nearly five times 33,000 lbs. raised 1 foot. Morin's fine work, "Sur le Tirage des Voitures," should be read by those interested in tramway or motor car work. Mr. Parker next rather summarily dismisses gas engines, there being "no reliable practical data available." Perhaps his search for information has not been extended sufficiently far, his chief objection to that form of traction apparently being to the "considerable admixture of gas with the atmosphere of the neighbourhood;" on this he may be referred to the evidence of Major-General Hutchinson, Board of Trade Inspector. When before the House of Commons Committee on Tramways Mechanical Powers Bill, he said respecting steam traction: "I travelled on the top of the engine with my nose over the funnel for two miles, and I did not perceive the least atom of noxious vapours coming out." Now what has been done once can be done again, and it is only through carelessness or ignorant management that both steam and gas have fallen into such thorough disrepute, but it will be a mistake to hold these motive powers too cheap, or to suppose that the last word has been said about them. With respect to the working cost of gas motor trams, Mr. Baker, in his excellent report to the London City Council, says:—"A line of seven miles (single track) has been more recently installed at Blackpool, and appears to be working economically, the expense of running per car mile is stated to be 4½1., a cost which compares favourably with other systems of traction." Finally as to costs, much seems to depend on the conditions of work, the cost or allowance for repairs and depreciation, a question very apt to be shelved. Thus, in his statement for overhead electric in comparison with other systems, Mr. Parker gives or allows nothing for repairs, motors, machinery, fuel, and ends with a total cost of 3 157d. as cost of running per car mile. But it is evident that the question will not be finally got rid of by such omissions. Electricity ranks high in its cleanliness, speed, and general suitability to public requirements, without pulling in to its support, economy—on which there is yet much room for dispute as to its superiority; much safer would it be to adhere to the strong points of its resources, and not raise questions in which it may be said that "you may prove anything by figures."

Mr. Parker, in reply, said that in his experience it was very difficult to obtain reliable analyses of costs of different systems of traction. It was easy enough to get large quantities of data, but the systematic analysis of these was rendered extremely difficult on account of the discrepancies between the costs data from different sources. The figures in his own table, however, he considered were quite reliable.

METHODS OF ELECTRICAL TRANSFORMATION.

By James Swinburne.

The only transformer to be considered a few years ago was the ordinary stationary alternating transformer; but with modern developments of extra urban supply stations, and with general supply systems, the most important transformer may soon be one of the numerous forms of dynamotor. A system of transformation in the sense of the title means a system for transforming energy at the power house to energy delivered to the consumer, and is therefore a large subject.

The general tendency, or fashion perhaps, for there are fashions even among engineers, is to generate triple currents, and to transform them into direct currents locally. There are other possible systems, however, such as generating high pressure direct currents, generating single or double currents, with transformation into any sort desired at the supply end.

As regards the generators, the direct current has the objection of high pressure commutator, and perhaps somewhat extra cost. The direct current was, however, originally put out of the running, because it demanded a dynamotor instead of a stationary transformer; but now that the rival systems demand the same when direct current supply is contemplated, direct current generation requires reconsideration, at least for moderately high pressures. It has never had fair play. The extra cost of the dynamos is a small matter, and their efficiency and the efficiency of the whole system may be higher.

The most important question is, in long distance work, the leads, consisting of copper and insulation. All sorts of precise statements as to the copper needed by each system are made, but such statements are meaningless unless the assumptions on which they are based are stated.

Take first the question of copper only. The first consideration in a comparison is, What pressure is to be used? The next, Is it the maximum, the effective, or the mean? The third, Is it as compared with the earth or with other parts of the circuit? It will be assumed that in all alternating currents the maximum pressure has to be taken as being the critical pressure as regards insulation rupture, and especially as regards life. For comparison a set of definite cases may be taken, say 10,000 volts and 2 square centimetres of copper at a density of 200 amperes per square centimetre.

Case 1.—The system earthed at a middle point, no wire to be more than 10,000 volts from earth. The direct current is then 20,000 volts and 200 amperes. The single alternating has 7,100 each side, the double alternating the same, but has its thick wire grounded and has smaller currents. The triple current has a middle point earthed, and though its wires never go over 10,000 volts above earth, they go more from each other.

Case 2.—One conductor to be earthed. This is a condition that may be compulsorily enforced, and practically means concentric mains with little insulation on outside conductor. In this case the direct current has 10,000 volts and 200 amperes, the single alternating 7,100 and 200, the double alternating is as before, but the triple current comes down considerably.

Case 3 is where the difference between no two conductors exceeds 10,000 volts. In each case the leads have a total area of 2 square centimetres, and a density of 200 amperes per square centimetre.

These results may be tabulated thus:—

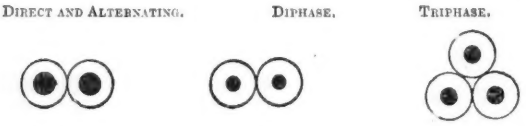
Case.	System.	Output in kilowatts.	Case.	System.	Output in kilowatts.
1	Direct	4,000	2	Double alternating	1,650
1	Single alternating	2,824	2	Triple	2,824
1	Double „	1,650	3	Direct	2,000
1	Triple	5,000	3	Single alternating	1,412
2	Direct	2,000	3	Double „	1,170
2	Single alternating	1,412	3	Triple	2,824

In all these cases the triple current is best and the direct second.

The next question is insulation, to which little attention is generally given. Questions of insulation resistance must be discarded as a criterion, and it must be remembered that the disruptive stress is not uniform throughout the insulation. The thickness of insulation has been calculated out on the assumption that at no part of the dielectric must there be a stress exceeding 20,000 volts per centimetre. It is unnecessary to give the calculations. The formula comes out—

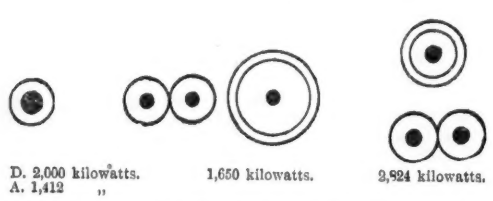
$$\log. R = \frac{E}{S\,r} + \log. r,$$

where R is radius of insulation, E is the pressure, S the maximum stress, and r the radius of the wire. It must be insisted on that this



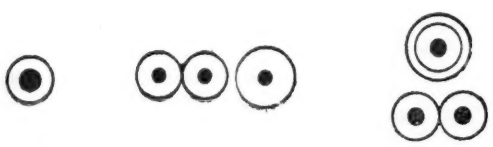
D. 4,000 kilowatts. 1,650 kilowatts. 5,000 kilowatts.
A. 2,824 „

Case 1.—10,000 Volts from Earthed Point.



D. 2,000 kilowatts. 1,650 kilowatts. 2,824 kilowatts.
A. 1,412 „

Case 2.—10,000 volts from Earthed Conductor.



D. 2,000 kilowatts. 1,750 kilowatts. 2,824 kilowatts.
A. 1,412 „

Case 3.—10,000 volts between Conductors.

is only an assumption. In practice cable-makers do not follow such a rule as this. It is only true for homogeneous dielectrics. Cable-makers vary their homogeneity by the unwilling introduction of spangles and other foreign bodies. It is difficult to find out what principles cable-makers work on. They indulge very largely in secret processes, which is always a suspicious proceeding, and it may be hinted, by other people, that cable-makers work in a haphazard rule-of-thumb way, without any principles whatever. Some of the cables shown are caricatures. A small solid conductor causes such a sudden fall of potential at its surface that a larger tube takes a covering of smaller diameter.

These figures go to show broadly that the direct and single alternating are preferable, as far as cost and convenience of insulation go, on the assumptions made. Distances are getting longer and pressures higher, and the cost of the cables is a more and more important matter. The cost of cables demands the most careful consideration, and it is to promote discussion in that direction that these diagrams have been made.

The whole question of loss by dielectric hysteresis is left out of this consideration. My own experience in this direction is with condensers rather than cables; but if there had been time it would have been considered too. It is important, and this way of losing power is peculiar to alternating and multiple currents.

As to cost of transformers, if direct current is needed for distribution there is not much to choose; if alternating is to be delivered the single alternating system has a clear lead right through.

As to convenience in measurement and handling, the direct current is far ahead, closely followed by the alternating, and the double and the triple come in a long way behind, if at all. Capacity effects, and all sorts of inductive effects are drawbacks peculiar to alternating and multiphase work. They are more troublesome in multiphase work. Bare copper conductors ought to be considered with reference to incipient discharge at the surface, and waste of power in the air. A tubular conductor is thus preferable and sometimes necessary, instead of a solid rod of the same cross sectional area.

In the absence of the author, Mr. James Swinburne's paper was read by Mr. Crompton.

The discussion was opened by Major Cardew, who said that in comparing alternating with direct current by taking the maximum voltage, the former system was handicapped. He considered that the virtual E.M.F. should be used as the value for alternating current. If the maximum voltage were taken, the shape of the wave must be known. In cases of shock there were three elements—time, pressure in the circuit, and power behind the pressure. He knew of a case where a momentary shock of 2,400 volts had caused no injury. He thought the author had been hard on the diphase system, and he considered the two-phase really was four-phase as usually four wires were necessary. For direct supply continuous current was the best, but impracticable for high pressures, single alternating was next best; two-phase was suitable for larger areas where power and light were both required, both phases could then be used for the motors; the three-phase should be kept for long-distance work with a motor at the end.

Dr. Edward Hopkinson said the diagrams in the author's paper were practically unintelligible; to take 10,000 volts as a basis of comparison was unfair to the direct current plant and 2,000 volts would be fairer. The economy of three-phase work was shown. Rotary transformers were simple, and they must look to the United States for experience. Present practice there seemed to point to the desirability of having a great central station producing three-phase current at 5,000 volts and distributing to a number of sub-stations.

Prof. Crehore agreed with Major Cardew about alternating current, and cited a case in which he recently had to test a submarine cable with 30 or 40 volts, and he considered that the virtual E.M.F. should be the basis of comparison.

Mr. Robert Hammond thought the paper very ambiguous. Personally he had had many years experience of the single alternating system, and it had signally failed to satisfy demands for light and power, otherwise no one would consider either two or three-phase work. He should like to know whether working two-phase systems with a common return introduced complication. A Bill before Parliament last year asked for power to supply 2,000 square miles of country with electricity and the expected saving was in cost of coal. He calculated the cost of copper would be £125,000, and reckoning 10 per cent. to cover interest, sinking fund, and maintenance, then the saving in cost of coal would need to be £12,500 yearly.

Mr. Crompton thought Case 3 in the paper the most interesting, but the information given was very incomplete. The three-phase system might be used for power jobs where the load factor would not exceed 0·7, and in such a case there would be no saving on cost of copper over direct current. He had recently seen Mr Brown, of Messrs. Brown, Boveri & Co., and he told him that Swiss and German engineers were agreed that there was no saving in copper on the three-phase system over the direct current.

Sir Henry Mance objected to the remarks made by the author about cable manufacturers, he had had India-rubber covered cables in use in Oxford for the last seven years with 1,000 volts direct current and no faults had occurred, the distances were about 1 to 1½ miles, and the company was paid for about 75 per cent. of the electricity generated.

Sir W. H. Preece took exception to the improper remarks made by the author about cable makers. If the cables supplied were not sound it was probably because the materials had not been properly inspected by the consulting engineer. It was a great evil that public bodies were employing so many men of little or no experience to carry out important works. He referred to a case at Lagos on the West Coast of Africa, where a death had occurred from a shock due to 1,000 volts only, the first fatal case in his knowledge with such a potential.

Mr. Bottomley thought the cable makers did their best. He heard that Lord Kelvin had just returned from Rome, and said that the insulating material of the cables showed signs of crumbling away.

Mr. Scott thought the price of rotary transformers about double that of the stationary type, but at present the 30 kw. size only ran at 1,200 revolutions. He suggested that it might be built to run at 3,000 to 4,000 revolutions with a vertical spindle and ball bearings, and the cost be reduced.

Mr. Vaudrey considered that hitherto the machinery had received far more attention than the cables. Ten years was at present a long life for a cable, and a great deal of cable had been found useless after a life of five or six years. Ground containing slag or salt would ruin lead-covered cables very soon. What would be the condition of sheet steel armouring in damp places after 12 years' use?

Mr. C. E. Spagnoletti had described his equilibrium system last year in a paper which had to be taken as read, and he now brought it forward once more.

MECHANICAL TRACTION BY ELECTRICITY.

By Granville C. Cuningham, M.I.C.E.

In the installation of mechanical traction by electricity on tramway systems the point to be considered is how this form of traction compares in cost of construction and working with that it displaces; and what are the conditions that make for a high or a low cost of working. It will doubtless be admitted that unless such form of traction were financially superior to other forms it would not be adopted; but it will be useful to inquire wherein this particular superiority lies, as this indicates the direction in which the skill and resource of the engineer should chiefly be turned. The cost of constructing and equipping an electric tramway system is very much greater than the cost of a horse system. The receipts per car-mile may not be much greater, and with the largely increased mileage run, may possibly be even less; therefore, unless the expenses per car-mile of the electric system are very much less than the expenses of the horse system, whence can be obtained the large additional net revenue required to pay interest and sinking fund on the greatly increased capital invested? It is accordingly to this lowering of the cost of electrical working that the attention of the engineer should be chiefly directed, and the best results in this respect can be obtained only by care in construction.

In the first place, on what item in working cost may a saving be looked for?

In the matter of wages of men on the car, no saving can be effected; two men would be needed on the electric as on the horse car, and the electric employés may even be expected to require higher wages. The maintenance of car-body—painting, repairs, and so forth—would be practically the same in either case; the maintenance of the electric equipment of the car is an addition to any expense of the horse system; so also is the overhead wire and feeder system; the maintenance of the track would be greater for the electric system, including therein the bonding. In all these items the cost in the total would be greater for the electric than for the horse system. There would be some advantage to the electric system in being able to run at a higher speed, thus distributing the wages of motormen and conductors over a larger mileage in a day, and reducing the amount of that item per car-mile. But this is not a large amount and would not compensate for the increase in the other items mentioned.

The only item remaining to be considered is the power used in the service, and it is in this item alone that the saving can be effected. For this reason the power house on an electric system is the point to which the intelligence and skill of the engineer should be mainly devoted. It is upon this that the financial success of the undertaking depends. If it is carelessly constructed with engines, boilers, and appliances that do not ensure a low cost of working, then it is certain that but a small profit—and perhaps no profit at all—will be realised. It is certain that no great financial success will be secured. Everything that will reduce the cost of producing the electric current should be sought out and applied in the construction of the power house.

The cost of horse traction—and by this is meant the cost of horse-keep, wages of grooms, shoeing, veterinary expenses, but exclusive of drivers' wages—may be taken as varying from 3½d. per car-mile in an easily worked town such as Glasgow, to 5d. per car-mile in a hilly and more difficult town, such as Liverpool. This is the cost of horse traction arrived at from the working of fairly large systems showing 7,000,000 car-miles annually in Glasgow and over 4,000,000 in Liverpool. The cost of electric power for traction on the overhead trolley wire system should, with economical engines, boilers, and heat saving appliances, be under ½d. per car-mile for an easily worked level town, and for a more hilly town with steep gradients, but slightly over ½d. per car-mile. The cost here meant is the cost of all wages, fuel, water, oil, &c., in the power-house, together with the cost of maintenance, repairs, and up-keep of the plant. The cars driven by this power are those weighing about 6½ tons when empty, and capable of seating 26 passengers inside. But in order to ensure this low cost of working, every care must be taken in the power house. In choosing its site, it should be placed close to a plentiful supply of water, where all that is requisite for condensing purposes may be had at a nominal charge, or merely for the cost of pumping. A river, canal, pond, or the sea, would afford what is needed. It should be conveniently situated for the supply of coal from railway line, canal, or wharf, so as to save the charges of handling fuel. One shilling per ton saved in cartage would amount to a very considerable sum in a year in a large traction station. But, needless to say, the most important matter is the type of engines, boilers, and heat savers to be used. The writer favours low speed (70 revolutions) compound condensing engines, such as are built by numerous English firms, boilers of the Lancashire or Galloway type, with Green's economisers. A plant of this character was constructed and worked under the writer's charge on the Montreal Electric Street Railway, with the result that the cost of producing current was a little under one farthing per kilowatt-hour, and the cost per car mile less than a halfpenny in the open months of the year, when coal could be obtained for 9s. per ton. The consumption of coal was 3·48 lbs. per kilowatt-hour, or 2·60 lbs. per E.H.P.-hour, and this was maintained during months of working. The average for a whole year was only 2·75 lbs. per E.H.P.-hour. It is not pretended that this is a phenomenally low rate of consumption. On board many of the large ocean-going steamers as low as 1·50 lbs. of coal per H.P.-hour has been reached with triple expansion engines; but the writer believes that few electrical power houses have been able to show better results than those mentioned. Nor is the result to be attributed to a very large output; precisely similar results can be obtained by using similar appliances on a smaller scale. In the Montreal house there were six 800-H.P. engines, and the daily output of current averaged 43,000 units. But the author has recently obtained similar results with a small cable plant on the Birmingham cable system. In 1897 this plant consisted of a pair of single-cylinder engines running at 53 revolutions of 287 maximum H.P., with Galloway boilers, and no special heat-saving appliances. It was necessary to increase the engine power to meet increased traffic. The author put in a pair of superposed compound condensing engines of 400 H.P., running at the same speed as before, and obtained condensing water from a well in conjunction with a tank and cooling tower. The result was that the consumption of fuel was reduced from about 325 tons per month, or 8·9 lbs. per car mile, to 6·5 lbs. per car mile; and the introduction of Green's economisers has further reduced the consumption to 4·7 lbs. per car mile, or to about 3 lbs. per H.P.-hour. On the Birmingham small cable system, the saving does not amount in money to a large sum, but on a great electric system running, say, 7,000,000 car miles in the year, 4 lbs. of coal saved per car mile, at 9s. per ton, amounts to £5,625 per annum; and it is this consideration that gives emphasis to the plea for an economical power house plant.

To return to the previous line of argument. Note what a large saving is effected when a cost of ½d. per car mile for power is substituted for 5d.; on a car mileage of 7,000,000 it means no less a sum than £131,250 per annum! and indicates the source whence the increase of net earnings may be obtained to pay for the heavy cost of electrical installation. The whole cost of working a large electric system, including working charges of all kinds, should be under 5d. per car mile; but this can only be obtained with a carefully constructed power house, where the works' cost of the current is cut down to a minimum.

The limits to which this note had to be confined prevent the introduction of any more elaborate figures or statistics than those given; but enough has been said to indicate that, in the writer's judgment, it is to the power house that the chief attention should be directed in order to ensure the financial success of an electric system. Other parts of the system claim attention, but it is on this that success or failure mainly turns. More money can be lost on the one item of power than would pay all the other working charges, and whether the high potential system with transformers, or the multiple unit system be adopted, the successful working ultimately depends upon having engines and boilers that will do their work with a low consumption of fuel.

THE ELECTRIC LIGHTING OF THE CITY.

LAST Thursday week the Court of Common Council had a very lengthy sitting to consider the question of the proposed granting of a provisional order to the Charing Cross and Strand Electricity Supply Company.

The Streets Committee reported as follows:—

"Agreeably to your instructions of the 29th ult., a letter was addressed to the City of London Electric Lighting Company intimating that, although your honourable Court is advised that the existing contracts are null and void, you do not desire to take advantage of the circumstance provided they are prepared to come to satisfactory arrangements in regard to the supply of electricity to private consumers; and the company were requested to forward any further proposals they might desire to make at the latest by Thursday morning, the 1st inst., it being pointed out that upon their reply would depend the nature of your answer to the Board of Trade. It will be in your recollection that the company had already offered to reduce the maximum price to 6d. per unit as from January 1st next, provided the Corporation would withdraw its request to the Board of Trade to defer the granting of the formal approval by that department of the company's system of continuous current.

"We now submit the following reply received from the company: 'Sir,—In reply to your letter of the 29th ult., I am instructed by my directors to state that they are unable to make any further proposals than are contained in my letters of the 17th and 24th ult. It is impossible that, in justice to its shareholders, this company can immediately reduce its charge to private consumers to 6d. I am to point out that the price fixed by the Corporation is 8d. per unit, subject to a sliding scale which, in the terms of the contract, is not yet applicable. Notwithstanding, the company have voluntarily reduced the price, and, as I have already stated, it is the avowed policy of the board to make further reductions as the financial position of the company permits. The question of price is not, however, the only one involved in the matter of giving an efficient supply to private consumers. There is the question of providing for the additional 50,000 to 60,000 lamps which will have to be supplied next winter. On December 20th, 1898, this company received from the Board of Trade a distinct intimation that they intended to approve the additional system of supply proposed by this company, and on the faith of such intimation my directors have ordered machinery, and have made arrangements for the expenditure upon continuous current plant of the sum of upwards of £70,000 to enable them to cope with next winter's increased demand. The Board of Trade, however, at the instance of the Corporation, are deferring the giving of their formal approval of that which they had already intimated their intention to approve. My directors invite the serious attention of the Corporation to this matter, as its action is calculated to seriously jeopardise the efficient supply of current to the citizens during the coming winter. I am to add that the introduction of the continuous current supply will not, as has been stated, involve a general reopening of the streets, but all that will be necessary will be to open the streets at a very few places in order to join up existing conduits.—I am, Sir, your obedient servant, J. CECIL BULL.'

"We have very carefully considered the said letter and further discussed the question of the future supply of electricity in the City; and, having regard to the fact that the before-mentioned offer of the company to conditionally reduce the price of the electric light to private consumers to 6d. per Board of Trade unit as from January 1st next did not find favour with your honourable Court, we could come to no other conclusion than that the company's answer is unsatisfactory, and that under the circumstances competition would be desirable, with a view to obtain a cheaper and more efficient supply of electricity in the City. In view of the letter from Sir Courtenay Boyle of the 24th ult., which was submitted at your last meeting, intimating that, in deference to the wishes of the Corporation, he would defer presenting the report on his inquiry to the Board of Trade until the 2nd inst., we at once forwarded to Sir Courtenay Boyle a copy of the company's reply, and informed him of the decision we had arrived at in reference thereto, pointing out, however, that the resolution we had come to would require confirmation by your honourable Court. We now ask you to confirm our opinion that, having regard to the unsatisfactory nature of the reply of the City of London Electric Lighting Company, competition, subject to such terms and conditions as may be approved by your honourable Court, would be desirable in order to secure efficiency of electric light and reasonableness of charges, and recommend that Sir Courtenay Boyle be informed accordingly."

Mr. ALGAR (Candlewick) suggested that the Court should hear a second report from the committee on the subject.

Mr. WALLACE (Vintry) objected to both reports being discussed as one. If there were to be any competition within the City, surely it should come from the Corporation. The Board of Trade and no one else had fixed the maximum cost of the current at 8d. per unit. He believed that the matter should be taken out of the hands of the Streets Committee, and that the time had arrived when some attempt should be made to come to a settlement. For that purpose, he thought, two Aldermen and two Commoners should be selected to settle the dispute. If competition were insisted upon, the Corporation would simply be handed over to another company.

The following report from the Streets Committee was then read:—

"Since our last report, dated the 5th inst., we have received the following letter from the Board of Trade with reference to the applications for provisional orders for the supply of electricity in the City, together with a copy of Sir Courtenay Boyle's report after his recent inquiry at the Guildhall in the matter: 'Sir,—Electric Lighting Acts, 1882 and 1888. With reference to previous correspondence on the subject of the applications by the Charing Cross and Strand Electricity Supply Corporation, Limited, the Metropolitan Electric Supply Company, Limited, and the Smithfield Markets Electric Supply Company, Limited, respectively, for provisional orders under the above-mentioned Acts in respect of the City of London, I am directed by the Board of Trade to transmit to you the enclosed copy of a report made to them by Sir Courtenay Boyle after his recent inquiry in the matter. I am at the same time to state that the Board approve of the recommendations contained in the report, and propose to act in accordance therewith. A provisional order will therefore be granted to the Charing Cross and Strand Electricity Supply Corporation, Limited, and the applications of the other two companies will not be granted I am to add that the Board propose to hold a meeting at this office on Friday next, 9th inst., at 3 p.m., for the purpose of settling clauses, and they would be glad if representatives of the City Corporation could attend.—I am, Sir, your obedient servant, T. H. W. PELHAM.'

"The conclusions arrived at by Sir Courtenay Boyle are as follows:—'With regard to the agreements between the City Corporation and the City of London Company, I am of opinion that they cannot be held to give that company any exclusive right of supplying electricity for private purposes within the City. The Electric Lighting Act, 1888 (Section I.), provides that the grant of authority to any undertaker to supply electricity within any area, whether granted by license or by means of a provisional order, shall not in any way hinder or restrict the granting of a license or provisional order to the local authority or to any other company or person within the same area. In 1889, after an exhaustive inquiry into the question of the electric lighting of the metropolis, Sir Francis Marindin reported that "in the abstract competition is desirable as tending to keep down the price, and to cause the manufacture and supply of electricity to be carried on with all the attention and energy which it is possible to devote to it." The Board of Trade thereupon adopted the policy, as regards the Metropolis, of granting powers to two bodies in respect of the same area, and this policy has been confirmed by Parliament. The two petitions to which I have referred, and the evidence tendered by various witnesses tend to show that there is a considerable feeling among consumers, ratepayers and others in favour of a competitive supply in the City. After a careful consideration of the evidence and arguments put before me, I am of opinion that a competitive supply is desirable both in the interests of private consumers and of the public, and I recommend that it be authorised. Having regard, however, to the representations made on behalf of the Corporation, I do not think that powers should be given to more than one of the applicant companies, and it remains to be considered, therefore, to which of the companies powers should be given. The operations of the Smithfield Company have been very limited. They have no statutory powers, and the strength of their financial position is not such as to justify exceptional consideration. Nor do their past operations afford a guarantee that they would be able to give a cheap and efficient supply of energy to a large and important area like the City. For these reasons, and, in view of the representations of the Corporation "that they do not recognise the company in any shape or form," I regret that I am unable to recommend the grant of an order to this company. The Metropolitan Company are already supplying energy over a large area adjoining the City. They are constructing a large generating station at Willesden, from which, when completed, they propose to supply energy for distribution throughout the whole of their areas of supply. This proposal, so far as it relates to the City, appears to me to present considerable difficulties, especially having regard to the powers of purchase given to local authorities by the Electric Lighting Acts. The company do not propose to establish a generating station in the City, and in the event of the Corporation exercising their powers of purchase, they would, under this scheme, acquire mains and distributing plant without any generating station. I am of opinion that great weight should be given to the representations of the Corporation that, in the event of competition being authorised, it should be subject to the Corporation being empowered to purchase an undertaking complete so far as the City is concerned. The company have displayed great energy in exercising the statutory powers which have already been conferred upon them in respect of other districts, and were they authorised to supply in the City I have no doubt their statutory obligations would be carried out satisfactorily. Their proposals do not, however, appear to me to meet the requirements of the Corporation, and I regret, therefore, that I cannot recommend the granting of an order to them. The Charing Cross Company are also supplying energy over a large area adjoining the City. It was stated in evidence that they would be prepared to keep the generating and distributing system for the City separate from those for any other district, but that, pending the erection of the new generating station, they would propose to give a supply from their existing station, where they have spare power available for the purpose. It was also stated in evidence that the company would be prepared to accept a clause giving the Corporation power to purchase the undertaking within a shorter period than that prescribed by the Electric Lighting Acts. I am of the opinion that the proposals of this company most nearly meet the wishes of the Corporation, as set forth in the resolutions adopted at the Court of Common Council held on April 10th last, and I recommend, therefore, that the consent of the local authority be dispensed with in the case of the application of the Charing Cross and Strand Electricity Supply Corporation, Limited, and that an order be granted to the company, subject to the following conditions: (1) That a clause be inserted requiring the company, within two years from the commencement of the order, to establish a separate generating station for the purposes of the City undertaking. (2) That power be given to the Corporation to purchase the City undertaking at any time after the expiration of a reasonable time, to be hereafter settled, from the commencement of the order, on terms to be agreed upon between the Corporation and the undertakers, or, in default of agreement, to be determined by arbitration.' We now beg to recommend that we be authorised to attend the proposed meeting of the Board of Trade on Friday, the 9th inst., and to prepare and submit to the Board all necessary clauses for the protection of the Corporation, with power to obtain, if necessary, the assistance of an electrical expert."

Mr. ALGAR said he thought the letter which had recently been received from the City Company should be read.

The TOWN CLERK then read a letter signed by the secretary of the City of London Electric Lighting Company. It was stated that the directors of the company had had before them a copy of Sir Courtenay Boyle's report, and they learned that the Streets Committee had decided to recommend the Court of Common Council to agree to competition. Before the Court took that extreme view and repudiated their contract, on the faith of which £1,500,000 had been subscribed by the public, the company desired to place before the Court various facts. In the first place, the company had fulfilled the conditions of the contract in every respect. The price of the current was fixed by the Corporation at 8d. per unit, subject to a sliding scale which was not yet applicable; but, notwithstanding, the company had from time to time reduced the cost, and had offered to further reduce it to 6d. per unit from January 1st next The company had expressed its willingness to surrender its rights to light the side streets provided that the company received the first offer of any contract for the lighting thereof; and the company was also prepared to sell the undertaking upon terms which would yield a handsome profit to the Corporation.

Mr. CROSS (Langbourn) asked that the resolution of the members on the subject from the Langbourn Ward Club should be read.

The TOWN CLERK read a resolution which had been arrived at by the members of the club to the effect that in their opinion the only solution of the difficulty was for the Corporation to supply its own electricity, and to buy out the present supply company.

Mr. ALGAR, in moving the adoption of the report, expressed regret that the City of London Electric Lighting Company had not seen its way to meet the committee with some favourable proposal. One of the reasons which had been given by the company was that it did not charge every consumer alike; that some were charged 3½d. per unit for the current, while others paid 7d. per unit. It was not always that under the existing arrangement the consumer who used the most electricity obtained it at 3½d., because if a man had one light burning a certain length of time he obtained a reduction, whereas another man who used 100 lamps for a less number of hours paid a far higher charge. Mr. Algar complained of the action of the City Company at the public inquiry, where, he said, no opportunity of asking questions was given to the Corporation. On the contrary, the company left the evidence given by the other companies perfectly whole and uncontradicted, and Sir Courtenay Boyle had only the evidence given by the other companies to consider. The committee were similarly placed, and on the 2nd inst. the members came to the conclusion that the time had now arrived when the citizens should be able to obtain a good supply at a reasonable and fair charge. The committee came to the conclusion also that the present Supply Company, on its own statement, was unable to supply the current at a fair and reasonable price. The members were convinced by the evidence that was given before Sir Courtenay Boyle that the other supply companies outside the City were willing and able to supply the electric current at a cost of 5d. per unit. As to the report from the Board of Trade, he failed to see how it could have come to any other conclusion, namely, that competition was needed; indeed, he had never heard a consumer of the electric light in the City say that competition was not desirable.

Mr. C. T. HARRIS (Langbourn) moved as an amendment that the letter from the City Company should be received, and that no action should be taken thereon. The Corporation, he said, was bound under its contract not to support the claim of outside companies. He desired to ask by what authority the Streets Committee had sent Sir Courtenay Boyle an expression of its own opinion, especially as that opinion was quite opposed to the expressed opinion of the Court. It must have been sent to influence him. If it was not, why, he asked, was it sent? The Board of Trade's report followed directly afterwards. He contended that the concessions which had been made by the Supply Company were as reasonable as could be expected, as it should not be forgotten that people had invested their money in the undertaking on the strength of the contract. A monopoly was able to supply the current at a cheaper rate, and that was why municipalities possessing the gas supply were able to make it cheaply. There would be, he complained, no real competition in dealing with only two companies.

After considerable discussion, we gather from the *City Press* report that this amendment was carried by 89 votes to 46, and it was subsequently approved as a substantive motion.

The LORD MAYOR, addressing the Court, said: For two hours you have been beating the air, and this has been a useless debate. The second report on the paper entirely superseded the first one; and in the second place, the Board of Trade, speaking in no uncertain voice, distinctly says that a provisional order will be granted to another company. This is surely the end of the matter.—Mr. Brooke-Hitching, rising amid much confusion, moved that the Streets Committee should have the matter referred back to them for further consideration.—Mr. Millar Wilkinson seconded this amendment.—Mr. Wallace expressed a hope that some delay would take place in order that the committee might have an opportunity of informing the Court what they were prepared to advise the Board of Trade to do. Why, he asked, should not some delay take place, as the Corporation did not exist for the Board of Trade. On the contrary, the Board of Trade existed for the convenience of public bodies.—The City Solicitor said the matter could not be further delayed, as the committee must meet the Board of Trade on the following afternoon. The amendment of Mr. Brooke-Hitching was voted upon, and rejected by a large majority.—Mr. Algar said he was asked to move that the resolution arrived at should be sent to the Board of Trade, and that it should be asked not to grant a provisional order to the Charing Cross and Strand Electricity Supply Corporation. This was not seconded, and it therefore lapsed.—Mr. Wallace then moved that the Streets Committee should first submit to the Court the recommendations they were going to make to the Board of Trade.—Mr. Brooke-Hitching having seconded this, Mr. Algar pointed out that that could not be done, as the committee must meet the Board of Trade on the following afternoon. The motion, on the show of hands, was lost.—Mr. Lile, amid more confusion, moved the adjournment of the Court.—Mr. Brooke-Hitching asked whether the Court that afternoon had given the Streets Committee the power to deal with the Board of Trade.—The Lord Mayor: The entire debate has been a waste of time for two hours. The Board of Trade will not be bandied about by the battledore and shuttlecock methods which have been suggested to-day.

Sir Courtenay Boyle sat at the Board of Trade on Monday for the purpose of considering the amendments proposed by the City to the provisional order granted to the Charing Cross and Strand Electricity Supply Corporation, Limited, in respect of the City of London. After the inquiry held at Easter, Sir Courtenay Boyle reported to the Board that the order should be granted, but that within two years the company should be required to establish a separate generating station for the purpose of the City undertaking, and that the City Corporation should have power to purchase the City undertaking "at any time after the expiration of a reasonable time to be hereafter settled." The Corporation now suggested, says the *Times*, that the date of the purchase should be December 31st, 1907, and that they should be at liberty to purchase the undertaking at its cost *plus* 10 per cent., a guarantee being given to the shareholders to make up their dividends in the interim to an average of 4 per cent. per annum. The Corporation also suggested that they should have the right to purchase part only, and not necessarily the whole, of the undertaking in the City, their main object being not to be compelled to purchase the generating station if it were erected outside the City boundary. Sir Courtenay Boyle said he should amend the order by making the date of the purchase 1914; and by giving the Corporation the power of approving the site of the generating station, but, in return, making it obligatory upon them to buy the generating station wherever situated in the event of their purchasing the City undertaking of the company.

The Board of Trade Report on the inquiry has been laid on the table of the House of Commons.

BRUSSELS ELECTRICAL EXHIBITION.

THE Brussels Electrical Exhibition was opened on Saturday, June 3rd, by H.R.H. Prince Albert. There were present:—The Director-General of Posts and Telegraphs, the Engineer-in-Chief, Mr. Wybauw, Director-in-Chief of lighting in Brussels, and many of the leading electrical engineers.

The exhibition makes a very good show. The following are the chief exhibitors:—La Société Universelle d'Electricité, lamps; F. R. Klaege & Co., bells, installations; Thomson-Houston, phonographs and graphophones; Dujardin Lammens, lamps, ventilators; Wehle and Co., Cristallerie; Siemens & Halske, arc lamps, ventilators, carbons, apparatus for measuring insulation, Röntgen ray apparatus; Manufacture des Glaces et Produits Chimiques de St. Gobain Chauny Girey, insulators and accumulators; Emile Closset, bells, indicators; Paul Mennessier, galvanoplastie, accumulators; Leroy, voltmeters and ammeters; Cristallerie du Val St. Lambert, chandeliers; La Nouvelle Precision, electric clocks; Van der Bist, bells, speaking tubes; Société du Telephone Privé, domestic apparatus, ventilators, military posts, fire alarms, cooking apparatus; Self-winding Clock Company, of New York; Land & See Kabelwerken Cöln-Nippes, cables, wires; Société Anonyme d'Appareils Telephoniques, telephone apparatus; Deutsche Kabelwerke, Worms, Hirshmann and Co., cables and wires; C. F. Duerr, voltmeters, ammeters, clocks; Reimers Eenberg, Lundell's motors, ventilators, insulating tubes, voltmeters; G. Boty, Société Anonyme, ventilators, heating and cooking apparatus; Henri Delvaux, arc lamps, domestic apparatus, bells, clocks, cables; Richez, lightning guards, bells, telephones; Co. Au Continental J. Brunt & Co.; Co. des Bronzes, lamps, chandeliers; Robert Dürr, carbons, lamps; Van der Windt, electric piano, motors, lamps; L'Etincelle, accumulators; L'Innovation Industrielle, desk with electric apparatus; J. H. Gauveid, bells; another exhibitor shows electric pianos, music boxes, graphophones; Manufacture General de Caoutchouc "Colonial Rubber," speciality of ebonite; Léon Carbeau, light accumulators; Société Anonyme l'Electrique, accumulators and medical apparatus; A. Petre & Co., insulators; Felten & Guilleaume, Mulheim, cables and wires; Société Anonyme Phaëton, lamps, cooking apparatus; F. Van Gompel, electric printing machine; Nothmann, electric serving machines; Ateliers de Construction Cristophe, electric machines, tools, motors; Tudor Co., accumulators; Allgemeine Electricitäts Gesellschaft, Berlin, ammeters, voltmeters, accumulators, cables, cooking apparatus; Ecole Nationale d'Electricité, all electric things made by the pupils; Riesenburger, electric pianos; W. T. Glover and Co., Limited, Salford, wires, cables, insulated by india-rubber, gutta-percha and diatrine; The Simplex Steel Conduit Company, Limited, simplex tubes; Mercier's Patents, Limited, watertight bells; Foxcroft & Duncan, London, Sappho arc lamps; Douglas Wells, M.I.E.E., Brussels, wires and cables.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

11,148. "Improvements in dynamo-electric generators and motors." S. G. BROWN. Dated May 29th.

11,166. "An improvement in electrolytes for deposit of metals." P. MARINO. Dated May 29th.

11,172. "An improved apparatus for controlling electric currents especially applicable for charging secondary batteries for accumulators." VERITYS LTD., and L. J. STEELE. Dated May 29th.

11,177. "Improvements in wireless telegraphy." G. MARCONI and the WIRELESS TELEGRAPH AND SIGNAL CO., LTD. Dated May 29th.

11,189. "Improvements in electrical machines." W. L. WISE. (Aktiengesellschaft Elektricitätswerke vormals, O. L. Kummer & Co., Germany.) Dated May 29th.

11,227. "Improvements in the ventilation of electromotors, dynamos and the like." J. P. HALL and G. A. ROBERTSON. Dated May 30th.

11,244. "Improvements in compounds for battery solutions." H. BLUMENBERG, jun. Dated May 30th.

11,249 "Improvements in electric devices for propelling and controlling vehicles." R. M. HUNTER. Dated May 30th. (*Complete*)

11,253. "A multiple series electric incandescent lampholder and plug." W. N. COLDWELL and G. E. COLDWELL. Dated May 30th.

11,272. "Improvements in rotary transformers and synchronous motors." R. BELFIELD. (B. G. Lamme, United States.) Dated May 30.

11,325. "Improvements in or relating to electric traction." A. BOCHET. Dated May 31st.

11,341. "Improvements in the commutators of dynamo-electric machines." W. LANGDON-DAVIES. Dated May 31st.

11,344. "Improvements in brush-holders for dynamos and like electrical machines." F. W. GOLBY. (I. Paprian, Germany.) Dated May 31st.

11,345. "Improvements in cartridges to be fired by electricity." W. FRIESE-GREENE and P. E. KNELL. Dated May 31st.

11,349. "Improvements in electrodes or plates for secondary batteries." L. G. LEFFER. Dated May 31st. (*Complete.*)

11,374. "Improvements in apparatus for lighting miners' safety or other enclosed lamps by electric currents." J. WARRINGTON and E. BROWN. Dated June 1st.

11,412. "Improvements in rotary transformers." J. MCLEOD MURPHY. Dated June 1st. (*Complete.*)

11,418. "Improvements in electric arc lamps." B. H. POMEROY. Dated June 1st.

11,422. "An improvement in electrolytic apparatus." J. G. A. RHODIN. Dated June 1st. (*Complete.*)

11,424. "Improvements in accumulator batteries." P. MARINO. Dated June 1st.

11,428. "An improved electro-magnetic device for use in connection with the propulsion and steering of ships and for similar purposes." D. BACON. Dated June 1st. (*Complete.*)

11,436. "Improvements in rheostats." C. TLOHR and R. DIETZE. Dated June 1st.

11,443. "Improvements in electric batteries." W. P. THOMPSON. (E. Giglio, Egypt) Dated June 1st.

11,445. "Improvements in circuit breakers." H. P. DAVIS. Dated June 1st. (Date applied for under Patents, &c., Act, 1883, Sec. 103, November 4th, 1898, being date of application in United States.)

11,446. "Improvements in systems of electrical distribution." C. F. SCOTT. Dated June 1st. (Date applied for under Patents, &c., Act, 1883, Sec. 103, November 4th, 1898, being date of application in United States.)

11,447. "Improvements in or relating to electric cables." G. E. HEYL-DIA. Dated June 1st.

11,449. "Improvements in apparatus for switching on and off lamps in electrical illuminations, particularly in advertising." A. F. BIDDLE. Dated June 1st.

11,456. "Improvements in contact boxes for electric tramways and the like." C. K. MILLS. (E. Bonnet, J. Paufique, and G. Linière, France.) Dated June 1st.

11,506. "Improvements in carbons for electric arc lamps." J. A. FLEMING. Dated June 2nd.

11,511. "A new or improved apparatus for the electric transmission of writing or manual signs, or figures, or the like." J. WEST. Dated June 2nd.

11,513. "An improved self-acting mule, with electrical driving-gear." W. BRETSCHNEIDER and C. W. LAUTCH. Dated June 2nd.

11,539. "Improvements in apparatus used in wireless telegraphy." G. MARCONI and THE WIRELESS TELEGRAPH AND SIGNAL COMPANY, LIMITED. Dated June 2nd.

11,552. "Improved electric tumbler switch." H. J. F. VOIGT and J. A. HALFFNER. Dated June 2nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9*d.* (*in stamps*).

1897.

23,329. "Improvements in and connected with substances to prevent polarisation in electric batteries." Dr. G. PLATNER. Dated October 11th, 1897. Primary Batteries.—The depolarising material consists of chlorates mixed with other substances which cause them to give off chlorine or oxygen by chemical or catalytic action. 2 claims.

24,111. "Improvements in electric conductor wire connectors." J. SHULTES. Dated October 19th, 1897. Relates to a coupling for wires, such as the conductor in an overhead traction system, so that in case a wire is broken the sections shall be completely disconnected. A block having side plates and wedge-shaped grooves is suitably supported. The conductors have cylindrical beads, which lock in the grooves when the wires are in tension. Instead of cylindrical beads the wires may have or be secured to wedges or blocks. Another form is one in which the wires have cross pins working in curved slots. A conducting plate is fitted in each form of connector. 2 claims.

24,157. "Improved clamp connection for electrical conductors." W. H. NICHOLS and W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED. Dated October 19th, 1897. Relates to a clamp connection particularly adapted for concentric cables. The clamp is adjusted before soldering. Each clamp consists of a loop fitted with a sliding piece forced down by a pressure screw. The strap has an extension to which the bridge piece is bolted. The sliding piece is formed with a cup and perforations for the solder. 1 claim.

24,382. "Improvements relating to the generation of multiphase currents and multiphase electromotive forces from single-phase currents and single-phase electromotive forces and to the utilisation of the same." F. TISCHENDÖRFER. Dated October 21st, 1897. Relates to means for generating polyphase currents and polyphase electromotive forces from single-phase electromotive forces for the purpose of starting or working alternating current motors, for supplying measuring instruments, arc lamps, or other electrical apparatus. One form is shown applied to an induction motor provided with two windings arranged at right angles to each other, and connected to the mains in parallel. In order to shift the phases of both electromotive force and current in the coil through equal angles, two induction coils are employed, one of which is wound with a single coil and the other with two separate coils. The first induction coil and the coil of the second induction coil are connected in parallel with one another, and in series with the motor coil 11, while the coil 1 of the second induction coil is connected across the mains. 6 claims.

24,470. "Improvements in joint boxes for electric cables." J. SHIPP and THE TELEGRAPH MANUFACTURING COMPANY, LIMITED. Dated October 22nd, 1897. Junction boxes are arranged with detachable sockets in which the ends of single or multiple conductors are permanently fixed by means of fillings, such as solder for lead-covered cables, or a mixture of wax, &c., for insulated cables. The sockets are attached to the junction box by means of screws. The inner conductors of a concentric cable are provided with connections attached by sockets. External conductors may be secured to lugs on the sockets. Fuses and links may be arranged between the connections. 4 claims.

24,520. "Improvements in overhead lines of electric railways or tramways." P. DAWSON. Dated October 22nd, 1897. Electric Railways and Tramways with Overhead Conductors.—Conductors, frogs for. The trolley wheel is guided by ribs, preferably curved, grooves and flanges, which may be movable. Movable blocking pieces, attached to a hand-operated counterweighted lever, block the groove on one side or the other. The main trolley wire is not cut, but is laid in a groove on the top side of the plate, and both it and the other wire are secured by solder, clamps, and set-screws. 4 claims.

24,884. "Improvements in electro-deposition apparatus." A. F. HARRIS. Dated October 27th, 1897. Relates to apparatus for electroplating small articles. The tank contains a removable frame which supports, by means of adjustable arms and rollers, the end rings of a rotating insulated or non-conductive cage. The latter consists of an open-ended cylinder having a removable end piece and a door, and sides formed with a series of grooves having a large number of holes. Within the grooves are attached by pins a number of cathode strips connected externally to a series of conductors, each of which is joined by a conductor to a commutator rotating synchronously with the cage. The wires pass over a rotating wood block, so that those conductors at the bottom of the cage are connected to the top of the commutator and hence are in circuit, and those at the top are connected to the top of the commutator, and hence are cut out. The cage and commutator are rotated from the shaft by suitable gearing. A bracket from the frame carries a bar or bars, to which one or more curved anodes are connected. The pin securing the cathodes have inwardly projecting ends, so that the small articles may be moved about thereby during deposition. In a modified form, the cage is formed of wires interlaced longitudinally and crosswise, and the cathodes within the grooves from a bar passing through the cage below the anode, the parts from the grooves to the bar being insulated. In a further modification, the cage is formed of links, connected by cross rods, and having inwardly projecting pieces serving as cathodes. 9 claims.

25,061. "Improvements in switches for electric motors." H. H. TURNER, A. TURNER, A. TURNER, and G. S. AVEYARD. Dated October 29th, 1897. Switches for motors are so arranged that the shunt or field circuit is first made, and then the armature circuit, the resistances being slowly cut out. A long arm is pivoted to a nut or contact mounted on a finely threaded screw. The free end of the arm is hooked to engage with the main switch arm, which is coupled with the shunt switch arms. The nut carries the armature contacts which rub over the resistance contacts. On operating the handle the main and shunt switches are first operated, and finally the armature circuit closed, the hook leaving the arm. On reversing the handle the resistances are first put in, and then the armature and shunt are both shut off by the point engaging with the end of the arm, springs giving a quick break. A bracket serves as a guide and support for the arm. A glass cover may be arranged over the main switch for use in emergencies. 1 claim.

25,244. "An improved arc lamp." P. MERSCH. Dated October 30th, 1897. (Date applied for under Patents, &c., Act, 1883, Sec. 103, October 11th, 1897, being date of application in France.) *Arc Lamps.*—A solenoid lamp is made with two shunt solenoids wound between discs brased on two slotted tubes and enclosed in iron to render their action uniform through the movement of their cores. Tubes and bars form the frame of the lamp. The iron cores of the solenoids are connected by an iron bar which carries the lower carbon as described in Specification No. 19,399, A.D. 1898, and are hung by cords or chains passed over pulleys and attached to the lighter upper carbon holder. This slides on guide bars carried by the end discs of the solenoids. The cords or chains pass through perforated plugs in the upper ends of the tubes. The pulleys are ratchet toothed to engage with pawls, which are slotted and supported on stationary pins, the carbon holders can thus move together freely, under action of the solenoids on the cores, but can only move apart to the extent of the sliding of the slotted pawls on the pins. For alternating currents, the iron is laminated and the cores are slit tubes filled with filings or wires, and are of different lengths. The pivoted pawls may be replaced by straight blades sliding vertically in fixed supports with screws limiting their motion. A modified lamp has only a single solenoid core, pulley and pawl. The provisional specification mentions a lamp with the coils and stationary conical cores. 1 claim.

25,246 "A process for the electrolytic separation of metals." H. VON DER LINDE. Dated October 30th, 1897. Relates to the electrolytic separation of metals such as separating copper, cobalt, nickel, tin, zinc, or copper nickle alloys from iron or manganese, the former metals existing as platings upon the latter, and consists in employing an electrolyte of ammonium carbonate solution. The anode is the plated article, and the cathode a metal similar to that to be deposited thereon. The iron or manganese is not attacked, and may be afterwards further treated in metallurgy. 2 claims.

28,338. "Improvements relating to pumps for exhausting electric incandescent lamps." F. J. SATCHWELL. Dated December 1st, 1897. The residual oxygen or combustion-supporting gas in a lamp bulb is converted into highly rarefied non-combustion supporting gas by striking momentarily an electric arc in a chamber through which the air in the lamp is drawn off. The arc is produced between two carbon terminals, one of which is flexibly supported so that a slight tap will move them apart and produce an arc, or the terminal may slide through a mercury-sealed joint. Some of the oxygen is occluded in the hot carbons. An incandescent carbon filament may be substituted for the arc. 2 claims.

28,382. "Improvements in and relating to commutator brush barriers for electric machines." H. H. LAKE. (Compagnie de l'Industrie Electrique, Switzerland) Dated December 1st, 1897. Brush-holders are formed of two arms held apart by spacing rods and mounted on a shaft. The free ends of the arms terminate in hooked portions and are provided with a spring or rigid gripping-lever. A clamping-collar is fixed on the shaft, and one or more springs cause the lever to hold the brush in position. 3 claims.

28,457. "Improvements in apparatus for regulating and controlling electric motors." L. HIGGINBOTTOM, J. H. HINDLE, and T. MANNOCK. Dated December 2nd, 1897. Electric Motors, Controlling.—Relates to controlling apparatus for motors, particularly applicable to elevators, hoists, or the like, starting under load. An abnormal magnetic field is first produced, and is gradually reduced. A series of contacts are carried by a sliding rod which descends by gravity, its movement being checked by a dash pot. Contacts are connected to the shunt coils, series coils, and resistances, and thence to the reversing switch for the armature. The coils are for an electro-magnetic brake. On operating the wheel the reversing switch is first operated through a quadrant, and then the rod is released through the action of a lever and cam. In the final position, the series coils are cut out of the armature circuit. The regulating switch is fitted with special contacts for breaking up the spark. The electro-magnetic brake is fitted with two blocks carried by the armatures of the electro-magnets and normally held against the brake wheel by a spring. When the current is flowing through the electro-magnets the armatures pull back the blocks. 4 claims.